

HAINES

**A MANUAL OF
PRACTICAL INSTRUCTIONS
TO OFFICERS
OF THE U. S. MARINE CORPS
IN FIELD WORK**

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Harold H. Henshaw, Lt. Col. U. S. M. C.

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FIELD WORK.



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These notes were prepared and submitted to headquarters by Maj. H. C. Haines, U. S. M. C., at that time attached to the staff of the U. S. Naval War College.

The compiler's thanks are due to the following-named authorities, as well as to those mentioned in the body of the work, for many of the suggestions, references, and quotations which are to be found in the within Manual of Practical Instructions to Officers of the U. S. Marine Corps in Field Work.

An Elementary Course of Military Engineering. Part 1.....	Mahan.
Attack of Fortified Places.....	Mercur.
Field Fortifications.....	Fiebeger.
A Text-book of Military Engineering.	Wheeler.
Mahan's Permanent Fortifications.....	Mercur.
Attack and Defense of Coast Fortifications.....	Maguire.
Fortifications	O'Brien.
Fortifications	Clarke.
Report of Board on Fortifications, etc., 1885.	
Tactics of Coast Defense	Wisser.
Defense of the Seacoast of the United States.....	Abbot.
Journal Military Service Institution.	
Artillery; Its Progress and Present Position.....	Lloyd & Hadcock.
Torpedoes and Torpedo Warfare	Sleeman.
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Manual of Instructions for Quartermasters Serving in the Field.	
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Notes on Naval Progress. Office of Naval Intelligence.	
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MANUAL OF PRACTICAL INSTRUCTIONS.

HASTY INTRENCHMENTS FOR MEN AND GUNS.

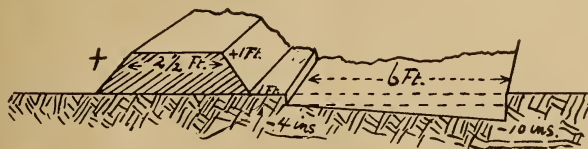
It is well recognized at the present time that owing to the intensity of fire of the modern small arm some form of shelter in the field of battle is made absolutely imperative. At times it will be found that ordinary lines of skirmishers will find natural shelter, but most frequently it will be found necessary to construct artificial shelter on the spot. The shelter used in battle, naturally, depends as to position, extent, and use on the terrain, and it must, therefore, be constructed at the time of battle and not before. Shelter of this character is known as "battle" or "hasty" intrenchments, and should fulfill the following requirements:

(a) The thickness of the earth embankment should be such that it will not be liable to penetration by small-arm projectiles or shrapnel fragments.

(b) The intrenchments should conform to the average heights over which men can fire in the various positions of lying prone, 1 foot, kneeling 3 feet, standing 4 feet 4 inches. The height of the earth embankment above the natural surface of the ground, however, should be small, in order that the trenches can be more easily concealed and less liable to be struck by artillery fire.

Generally speaking, hasty intrenchments consist of cover for (1) skirmishers, lying, kneeling, or sitting; (2) firing line, supports and reserves, kneeling, sitting, or standing; (3) gun pits and epaulments.

The shelter trench for skirmishers lying down is shown in the accompanying sketch.

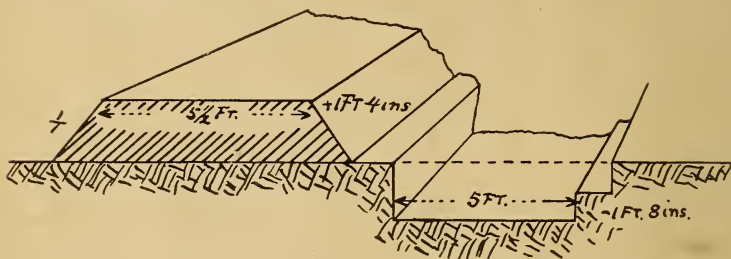


This trench gives earth protection to a thickness of $2\frac{1}{2}$ feet, and this thickness of loose earth is supposed to stop small-arm projectiles under ordinary circumstances. The average time required by one man to make 5 feet (2 paces) of this trench is, with pick and shovel, fifteen minutes; with small intrenching spade, twenty to twenty-five minutes.

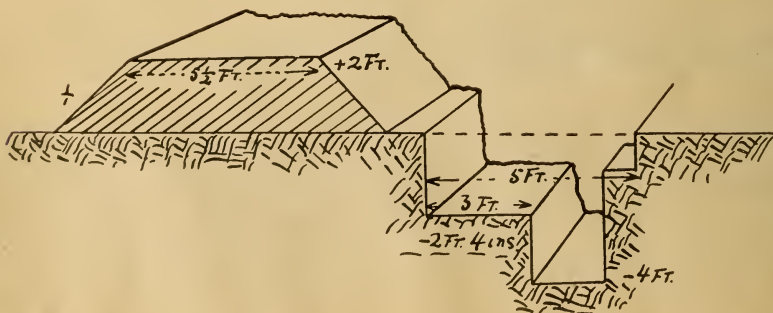
The number of skirmishers that can use this trench is usually computed on two for each 5 feet of length, although three may occupy the space by lying partially on their left sides. In firing, the left arm rests on the berm.

For men kneeling in two ranks, cover is gained by deepening the trench already dug 1 foot and 8 inches, and making it 5 feet wide, with an embankment in front having a height of 1 foot 4 inches and resulting thickness of about $5\frac{1}{2}$ feet. The average time required by one man to transform 5 feet of the trench "lying" into the trench "kneeling" is, with large pick and shovel, twenty-five minutes; with small intrenching spade, forty-five minutes.

Infantry in double rank, kneeling, can fire from this trench, the number of rifles being computed at four for each 5 feet length of trench. Men sitting can get protection from this trench, but horizontal fire is impossible. The trench is shown in the accompanying sketch.



Cover standing is obtained by deepening the kneeling trench 4 feet, leaving a step 20 inches in height and 3 feet wide next the front wall, so as to facilitate leaving the trench to the front and at the same time allowing a protected passage in the rear. The step serves as a banquette for men firing over the embankment. The embankment is given a height of 2 feet, the resulting thickness being $5\frac{1}{2}$ feet. The average time required by one man to transform 5 feet of the trench "kneeling" into the trench "standing" is, with large pick and shovel, one hour. The standing trench is shown in accompanying sketch:



If it be desired to have isolated trenches for single skirmishers lying, they should be made with the same section as figure 1, and have a length of one pace.

Isolated kneeling trenches for two men should have a length of one pace, but the isolated rifle pit or shelter standing should be 5 feet in length. This last readily accommodates three men, two of whom can fire over the embankment, while the third standing in the 4-foot trench protects the flanks.

When it is desired to intrench supports and reserves the cover kneeling and standing should be used in parallel rows close to one another. The shelter for supports and reserves is shown in the following sketch:



In the construction of trenches plows will come in very handy, and two or three of them following each other at intervals can be used to great advantage.

In the following sketches the trenches are all made on level ground and are simply *types*. On slopes they must be modified so that the tops of the epaulments are, in general, parallel to the ground. They may also be varied according to the kind of earth, sand requiring less thickness of embankment and greater slope than a clayey soil, while sod mixed with earth allows greater penetration than earth without it.

LOCATION OF TRENCHES.

The question of the location of trenches depends primarily on tactical situations, and secondarily on the nature of the ground.

Primarily they should always occupy a position giving the greatest development of fire, and hence are generally located near the crest of the most abrupt slope, i. e., near the military crest.

The exact position is determined by placing the eye at a distance above the ground equal to the proposed height of the embankment, and then selecting that line which gives the clearer field of fire to the front.

Secondarily it is desirable in locating trenches to avoid stony ground, and that close to the edges of the woods, the former on account of the liability to flying fragments should the embankment be struck by artillery projectiles, and the latter by reason of the difficulty in constructing the trenches.

INTERVALS IN LINE OF TRENCHES.

In all trenches, except those for skirmishers lying down, intervals in the line should be left for the passage to the front of artillery and cavalry; this is especially necessary when cover standing is used. The intervals may vary in width according to circumstances, but should never be so wide as to preclude their defense by the trenches adjoining the opening.

SPLINTER PROOFS.

When it is found that the troops are to remain in the trenches for some time, they should be protected with splinter proofs or some other kind of shelter. Planks, old lumber, doors, etc., may be used. They should be laid with one end on the embankment, the other resting on the ground and in the rear of the trench and covered with 3 or 4 inches of earth. This, though not proof against bursting shells, is proof against dropping bullets and shrapnel fragments.

CONCEALMENT OF TRENCHES.

The position of shelter trenches should always be concealed and the location disguised by covering the sides toward the enemy with branches, weeds, sod, etc.

In connection with the subject of hasty intrenchments may be mentioned the subject of loopholes. These may be formed by half imbedding hard logs in the embankment or resting them on sand bags on top of it and leaving space beneath for the rifle. The loophole may also be formed with four sand bags; brushwood may also be used with earth cover. Loopholes for rifles should splay inward; for guns, outward.

COVER FOR GUNS.

Cover for guns may be obtained in two ways—(1) By means of gun pits, which are made by digging a hole of sufficient size to partially conceal the gun and gun detachment and forming an embankment in front with the excavated earth; (2) By means of gun epaulments, which are made by constructing an embankment in front of the gun which rests on the natural surface of the ground. The gun detachments can be sheltered in the pits from which the earth has been taken to make the embankment.

Circumstances will control the selection of the one or the other of the above means of protection.

In connection with the subject of hasty intrenchments, the following data are deemed important:

THICKNESSES OF MATERIALS FOR PROTECTION AGAINST INFANTRY FIRE.

The following thicknesses of materials may be considered as ample for complete protection against infantry fire:

Sand	inches..	30
Earth	do ..	39
Stacked sod	do ..	79
Packed snow	do ..	79
Sheaves of wheat	feet..	16
Pine	inches..	39
Oak	do ..	24
Steel plates	inch..	$\frac{3}{4}$
Brickwork, provided joints are broken	inches..	30
Crib of broken stone	do ..	8

A wall made of two sand bags laid as stretchers, or of a row of sand bags laid as headers.

A wall two bricks thick, breaking the joints, will stop any one bullet, but after a time the bricks will be smashed and some bullets get through.

A well-built wall with fine joints set in cement mortar, 9 inches thick, is practically bullet-proof.

A 24-inch sun-dried brick wall is fairly bullet-proof a short time after setting.

One gabion filled with earth, or three well-made fascines, will stop a bullet.

With the Spanish Mauser rifle the maximum fixed danger zone against standing infantry is 640 yards from the muzzle; against cavalry, 740 yards.

The Germans claim that the surface presented to shrapnel bullets by a man lying down is practically the same as a man standing in the open; therefore they do not believe in broad, shallow trenches. They advocate the making of trenches in the natural soil with the fresh earth carried away, or used for dummy trenches so as to deceive the enemy's artillerists and prevent execution from shrapnel fire. The principal objection to this type of trench would seem to be the impracticability of getting the wounded out of the trenches or of getting reinforcements, either of men or ammunition, into them without undue exposure to fire.

Protection against ordinary field artillery fire is afforded by parapets of the following thicknesses: Sand, 10 feet; earth, 13 feet; clay, 17 feet.

The mean penetration of shells from siege guns, with a striking velocity of about 800 feet, is:

	6-inch guns.	8 and 10 inch guns.
	<i>Feet.</i>	<i>Feet.</i>
Sand, mixed with gravel	9.84	11.48
Light earth	13.12	16.73
Light earth, loose (newly stirred up)	14.76	20.34
Clay (argillaceous earth)	21.33	27.89

Dimensions of craters made by 6 and 8.5 inch shells.

	6-inch.		8.5-inch.	
	Diameter.	Depth.	Diameter.	Depth.
	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>	<i>Feet.</i>
Clayey earth	16.48	4.9	22.3	6.9
Calcareous sandstone	13.1	3.3	16.4	3.9
Concrete	9.8	3	11.5	3.3
Rough masonry	9	2	6.6	3

It is not considered necessary or desirable under ordinary conditions to build emplacements or magazines for the smaller calibre guns. They should be well masked, and depend principally upon their invisibility for protection.

GUN EMBLEMENTS.

Previous to landing the guns, etc., a competent officer or officers should be sent ashore to make a careful survey of the land and the approaches and select the sites for the various guns. The site being selected, the exact position of each gun should be marked by a stake or some conspicuous object.

In landing for the purpose of occupying and fortifying a port, the stores and materials should be landed in the following order: 1, three days' supply of water and rations for shore working party; 2, camp equipage and intrenching tools; 3, gun platforms; 4, transporting ways, etc.; 5, gun mounts; 6, guns and ammunition; 7, stores and supplies.

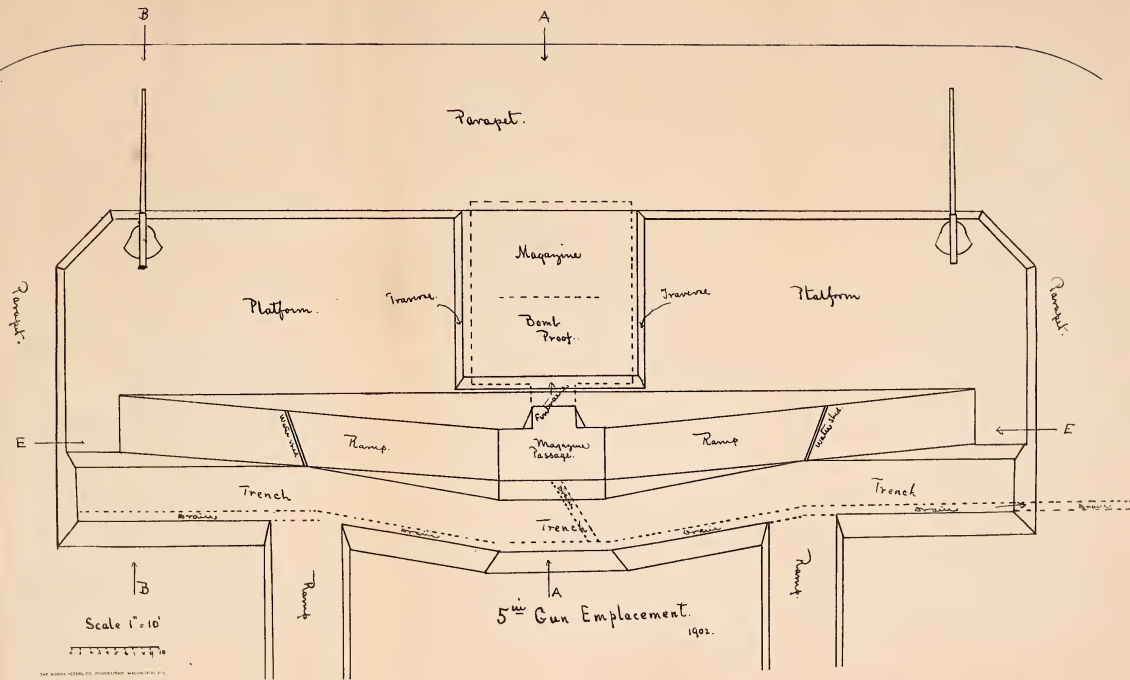
Presupposing a moderate degree of haste upon landing, the working party should be divided into two details—one to establish the camp, the other to begin at once the erection of the fortifications.

The officer in charge of the construction of the emplacements should have landed previously and marked out the traces of the gun platforms, magazine, front and rear edges of the parapet and trenches, in the order named.

It may be in order here to give some data as to the amount of work which should be expected and the manner of performing such work. One man, in fair soil can excavate 1 cubic yard per hour, or 80 cubic feet in four hours; 12 feet is the greatest distance an ordinary man can throw earth; 4 feet the greatest distance same can lift earth out of excavation. When necessary to throw earth more than 10 feet horizontally, extra shovelers should be provided for the handling, in the proportion of one shoveler to every two diggers; each man in working party carries one pick and one shovel.

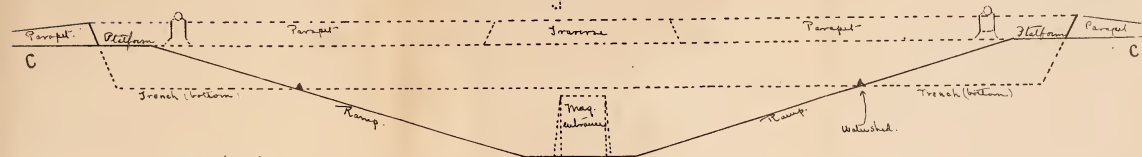
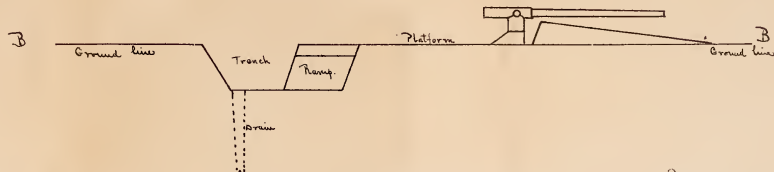
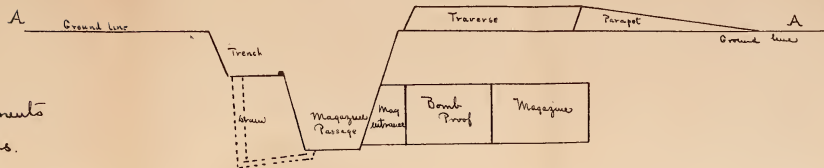
Too much trouble can not be taken in detailing working party so that: 1, they arrive at the site ready with tools; 2, their tasks must be clearly defined; 3, the men must be in such formation as will admit of their ready distribution to their work.



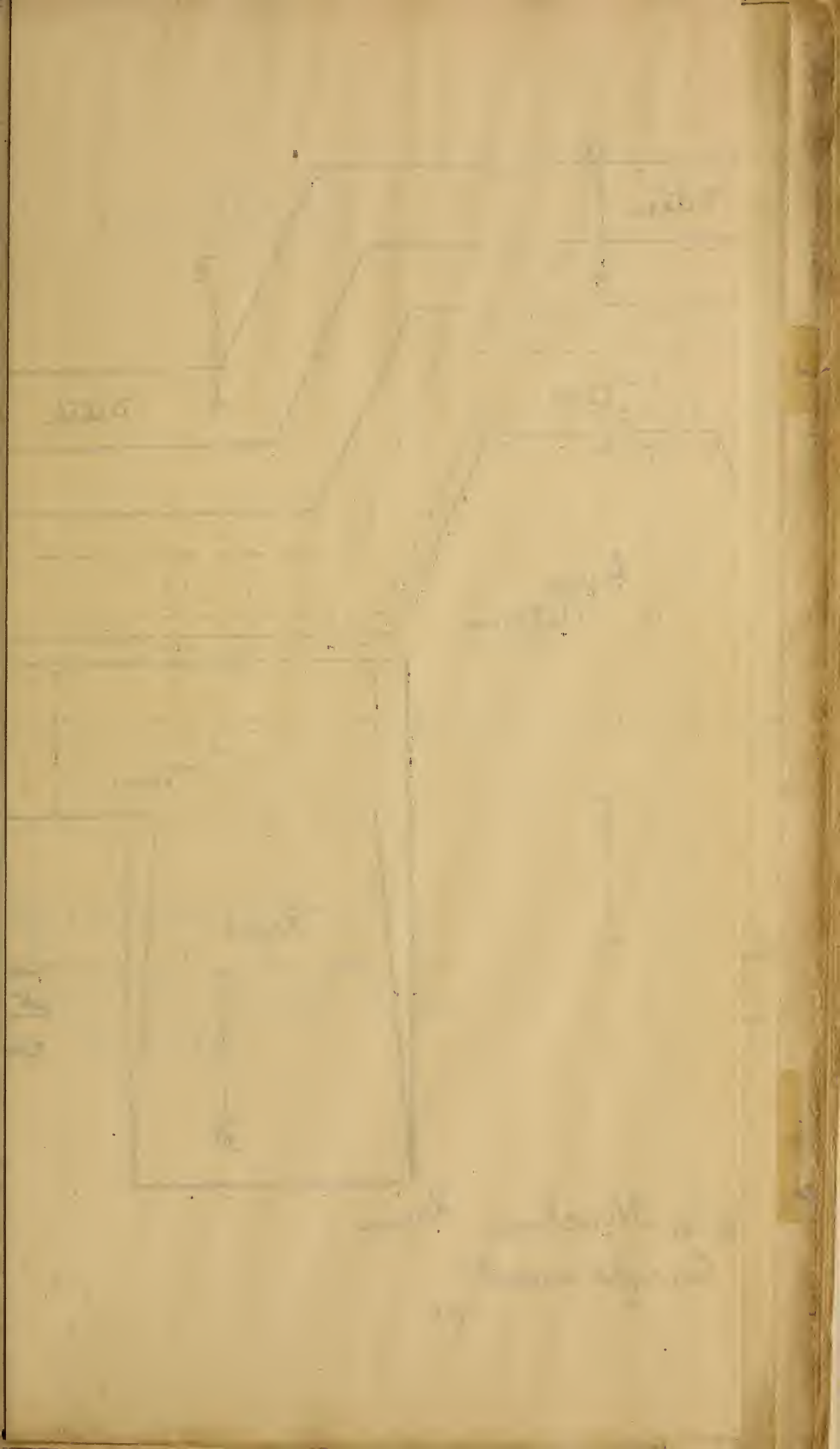




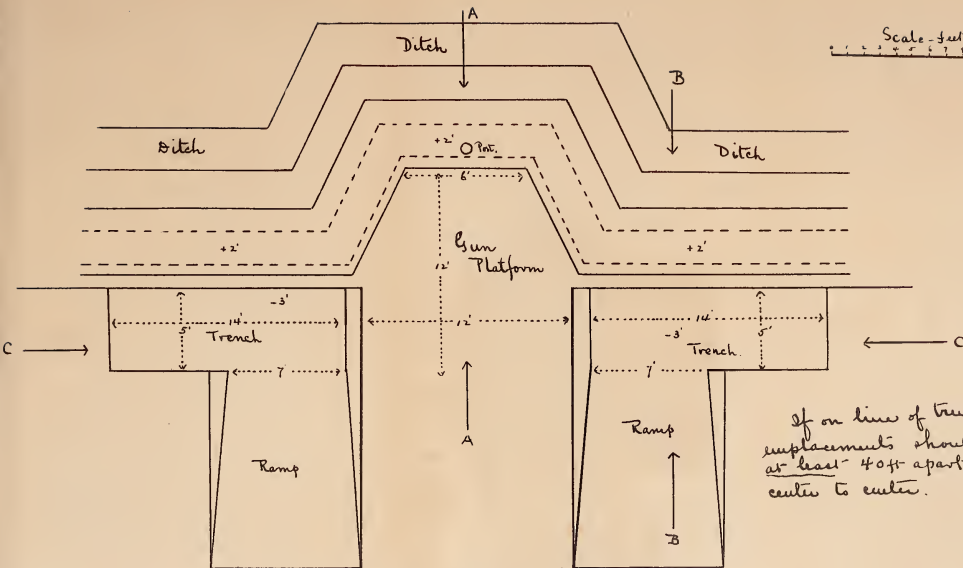
5th Gun Emplacements Cross sections.



Scale 1" = 10'.
1902.

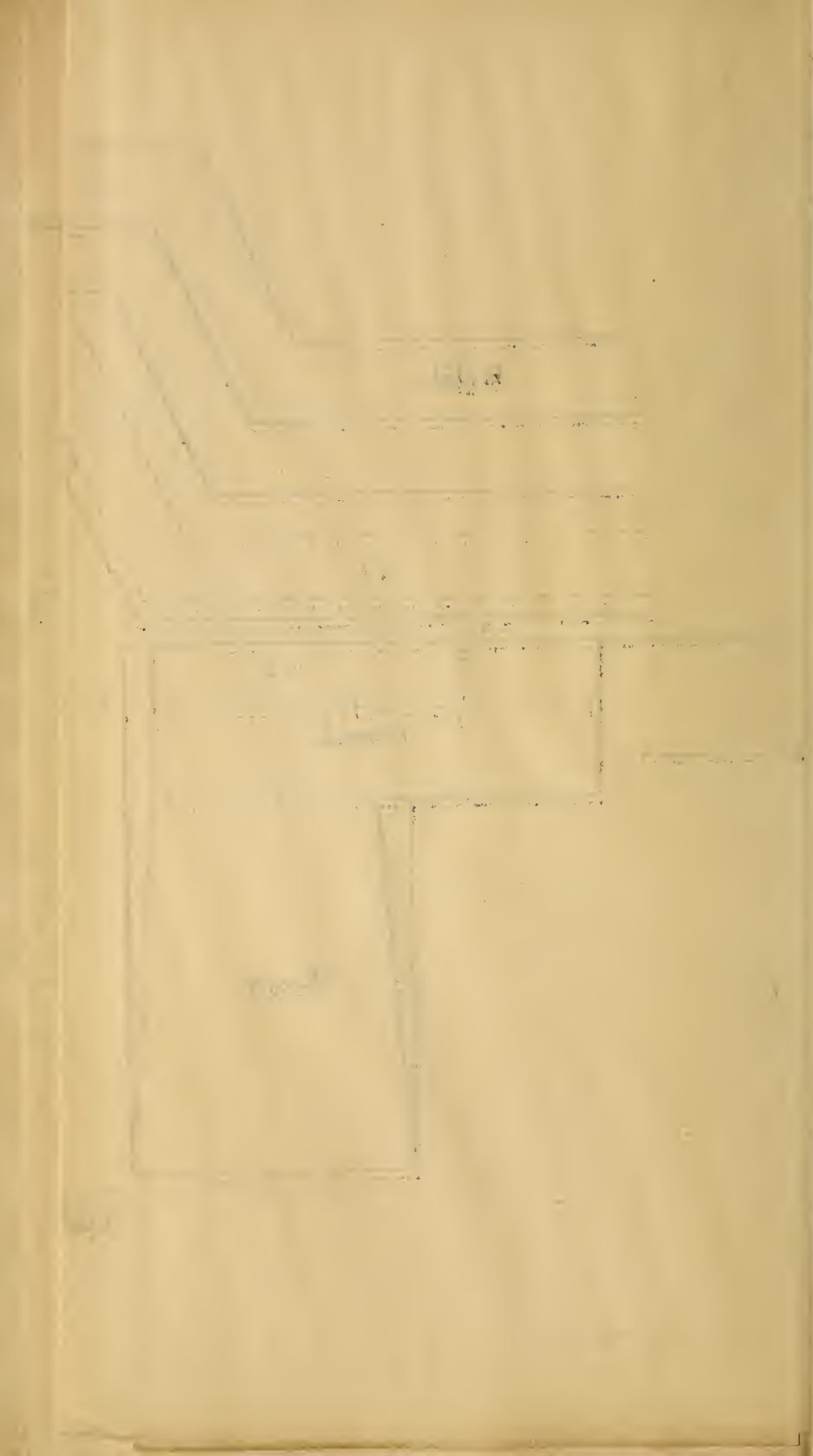


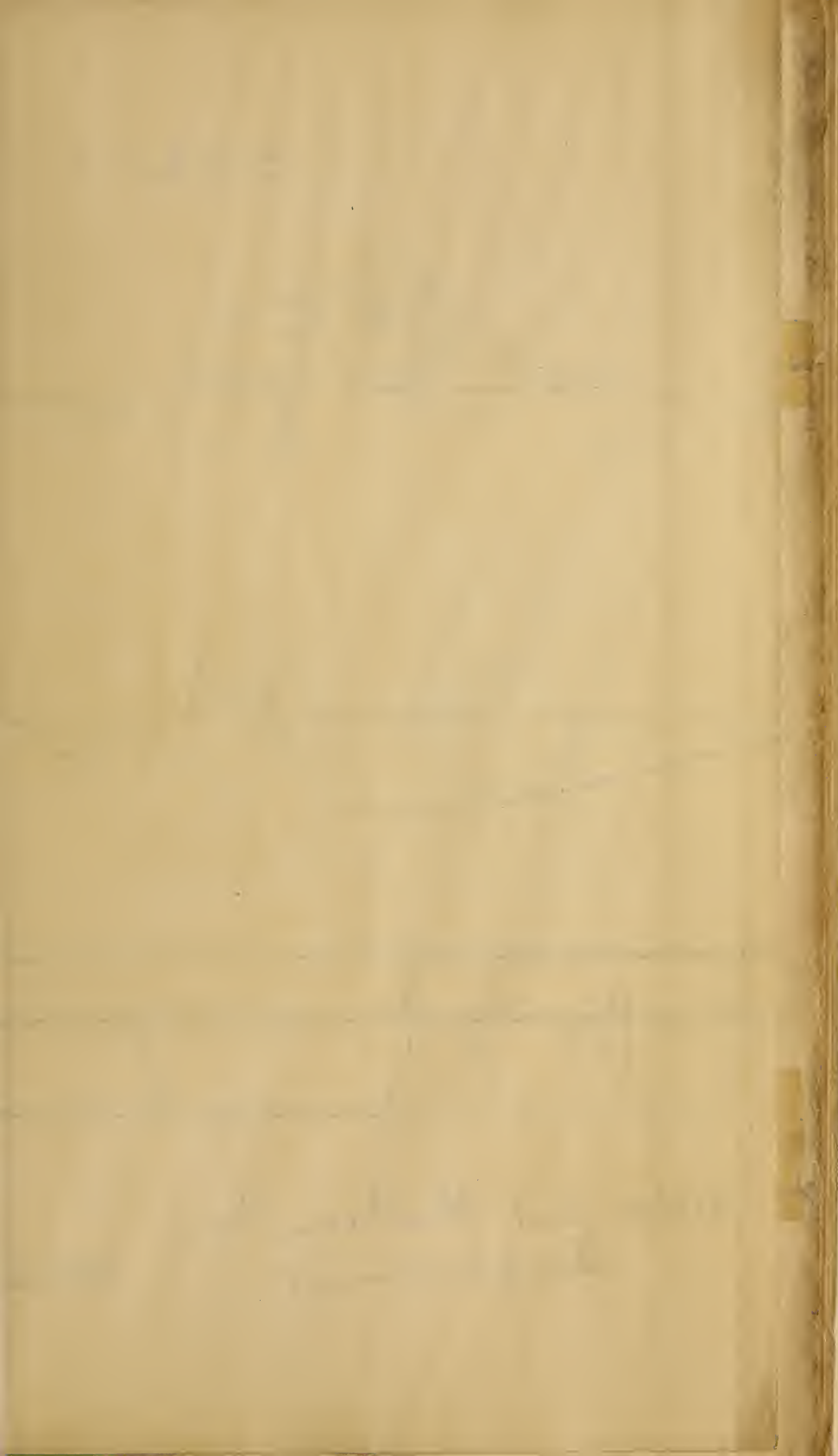
Scale - feet
1 2 3 4 5 6 7 8 9 10



If on line of trenches
emplacements should be
at least 40 ft apart from
center to center.

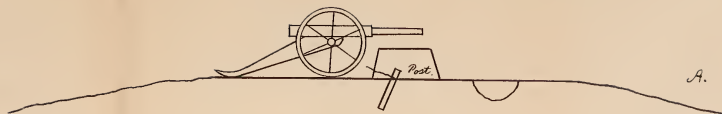
Field or Machine Gun
Emplacement
1902.



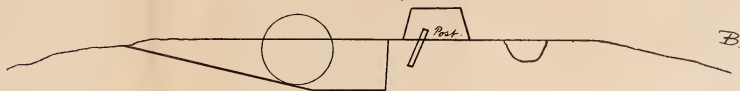


Scale $\frac{3}{16}" = 1'$

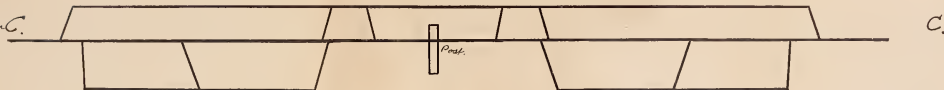
Section A.



Section B.

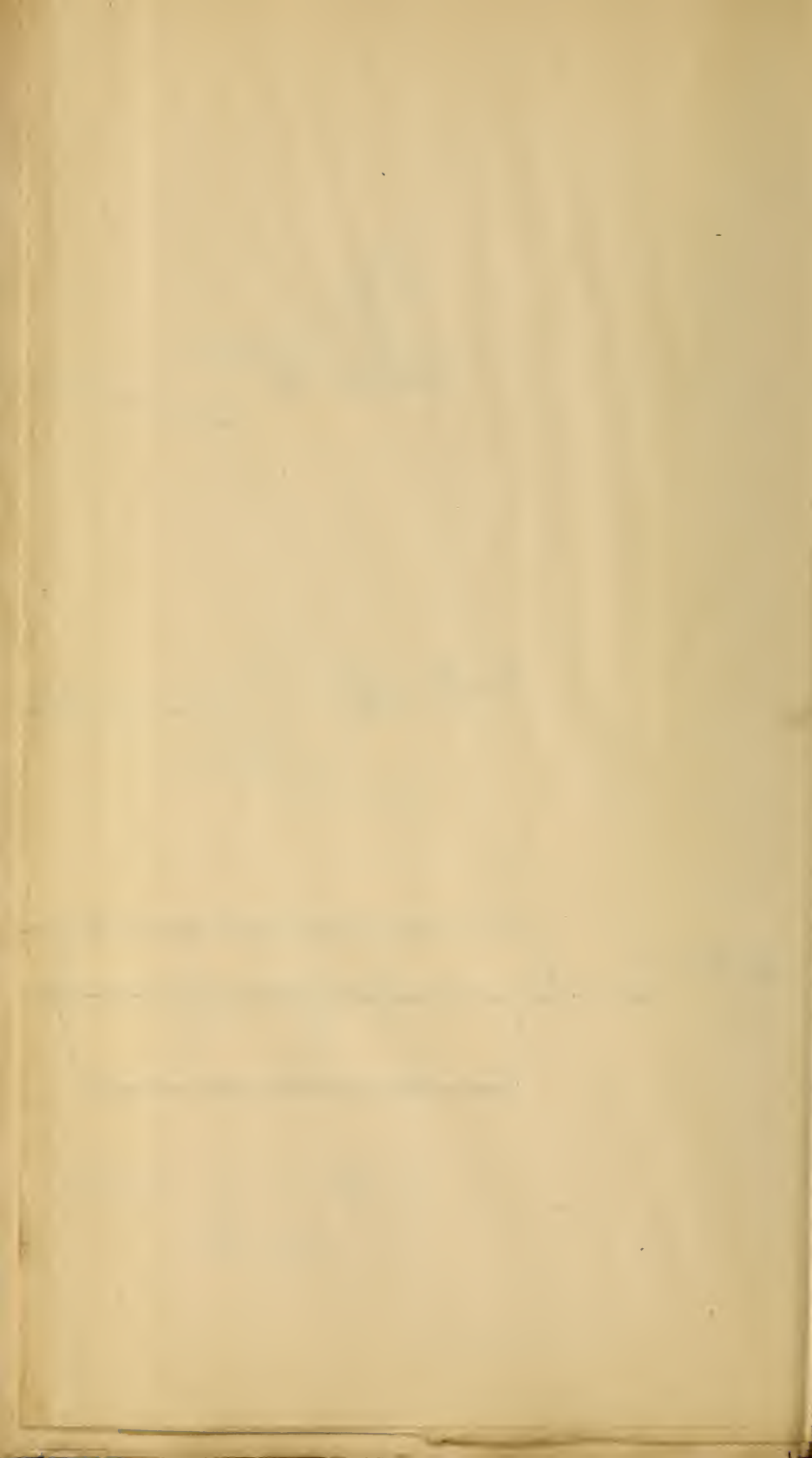


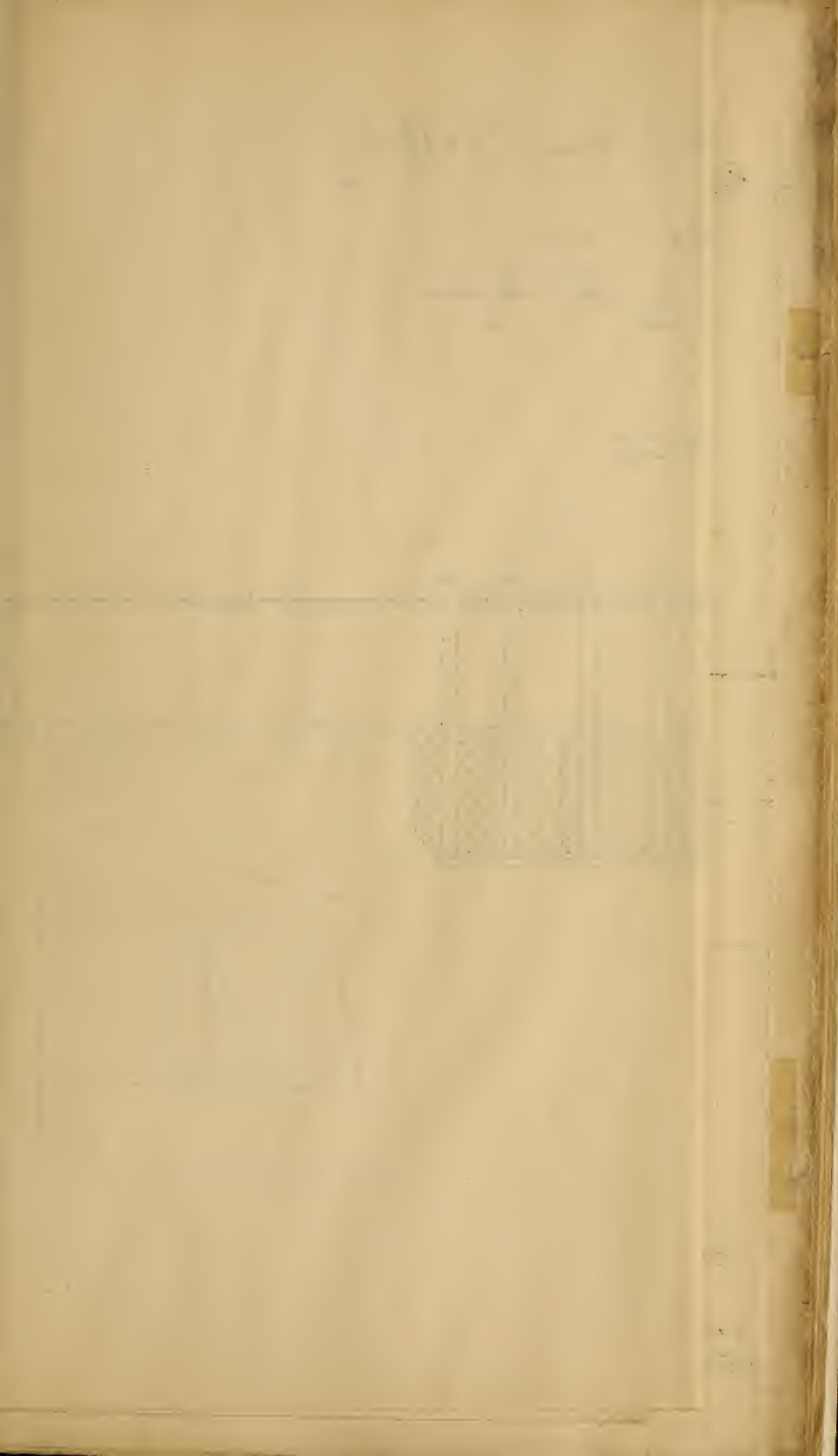
Section C.



Field and Machine Gun
Emplacement

Scale $\frac{3}{16}" = 1'$

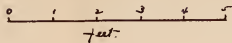




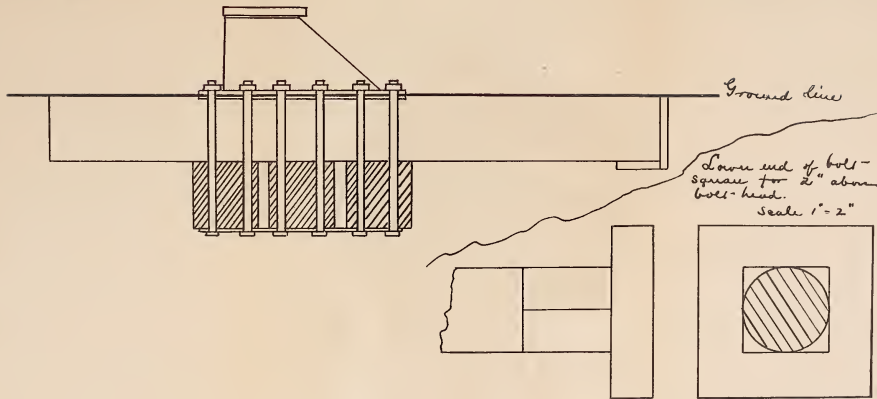
5th Hasty Gun Platform

1902.

Scale 1" = 2'

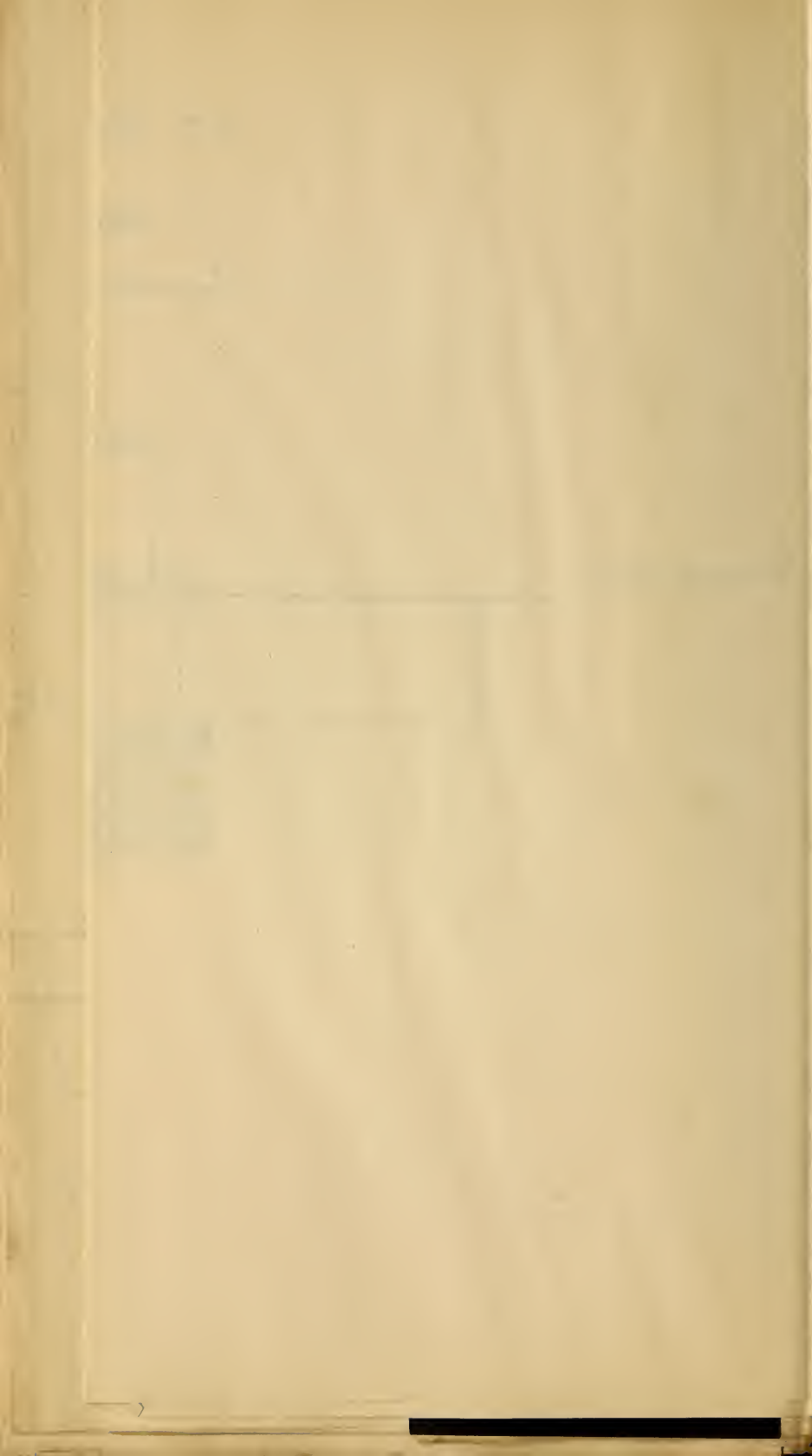


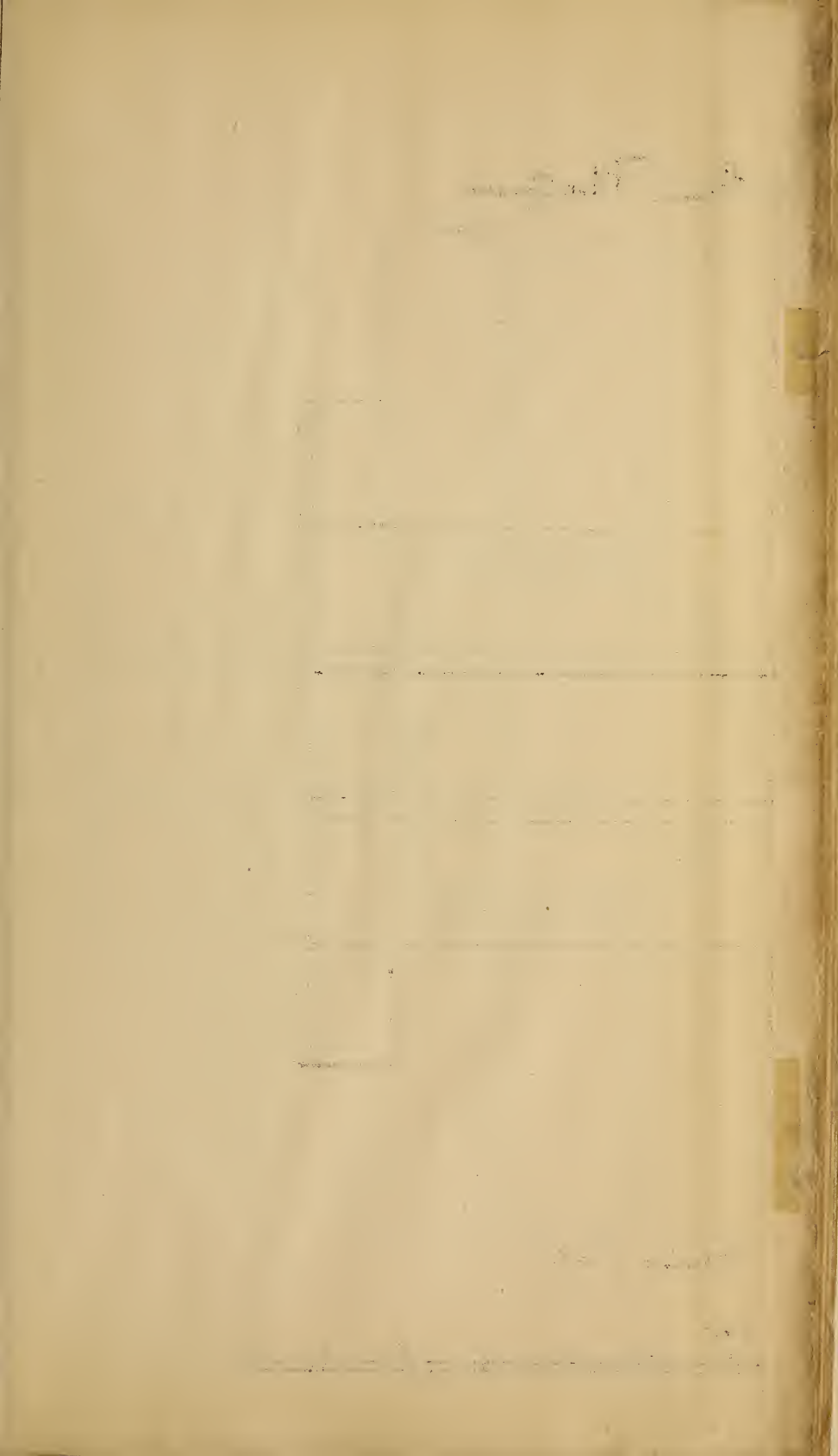
Ground line



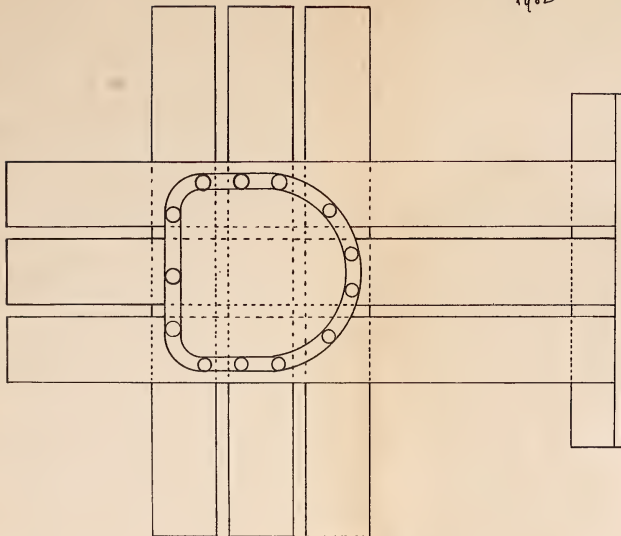
Lower end of bolt-square for 2" above bolt-head.

Scale 1" = 2"

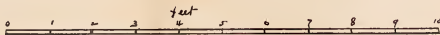


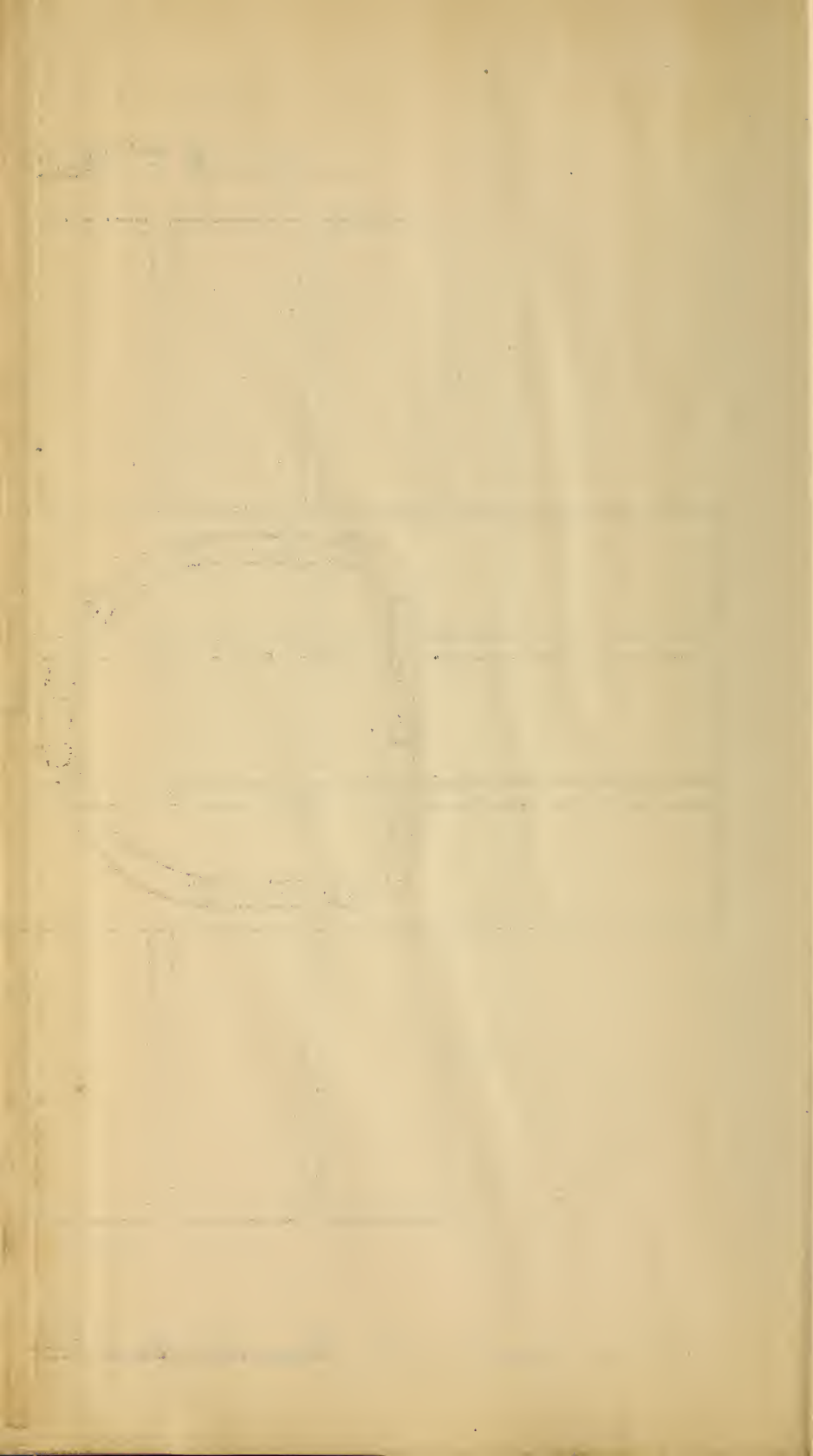


5th Hasty Gun Platform
1902

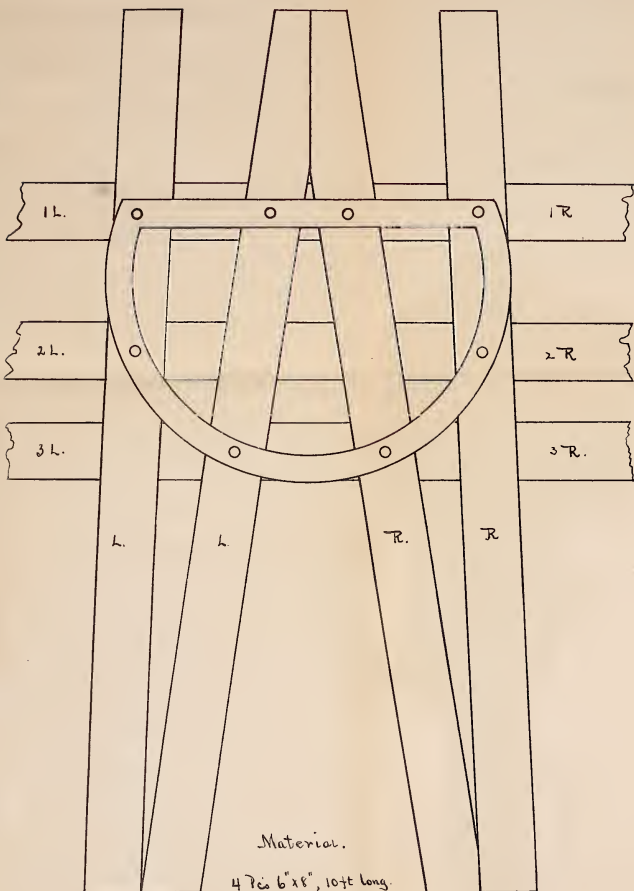


Scale 1" = 2'





6 and 3 pdr Hasty mount.



Material.

- 4 Pcs 6" x 8", 10 ft long.
- 3 " 6" x 8", 8' "
- 8, or required "H" holding down bolts, 15" long.
- 8, or required 1/2" plate washers about 4" sq.

Attached hereto are drawings showing in detail an emplacement for 5-inch B. L. R. and 3-inch B. L. R., as well as 5-inch Hasty Gun platform and 6 and 3 pdr. Hasty Mount. The drawings are given in such detail that further explanation is not deemed necessary.

Where tools are laid out, the intervals between sets of tools should be one pace. If only one tool is carried, it should be carried in the left hand. No work must be commenced until the distribution of the whole working party is complete, as it is difficult to remedy mistakes when working party has begun. Men should lie down and await orders. When orders are given to commence work, all set to work to cut and build up the surface sods along the parapet line (when sods are to be used in revetting). Each man excavates a hole of the required depth at the left corner of his task. The pick, for safety, must be worked from front to rear and never across. To use the pick, raise it well above the head with both hands, bring it down, allowing its weight to do the work, and letting the helve slide through the hand nearest the head. The shovel is used either right or left handed, some people making great use of the thigh in thrusting the shovel under loose earth. There should be no jerk in throwing the earth from the shovel. Left or right hand must slide freely up the handle; if it does not slide, the earth will scatter. If not under fire, throw the earth first excavated farthest. *The superintendent of working parties should be relieved at alternate hours to working parties.*

Revetments should be made as steep as possible consistent with their purpose. Where available, sod makes the best revetment; failing this, sheet-iron gabions or fascines, or sand bags make excellent revetting material. Durability may decide in many instances what material should be used.

In making the emplacements shown in the plan the following order of work should be adopted: 1. Site cleared and traces of work laid out. 2. Pits for gun platforms dug; the earth from this can be put in sand bags (where these are to be used for revetments) and placed along the inner line of the parapet in front of gun to protect the gun's crew from rifle or machine fire; if sand bags are not available, the earth should be thrown in front of the gun. 3. Magazine excavation started. 4. Gun platforms put in place and guns mounted. 5. Field of fire cleared of obstructions.

In an emergency the battery is now ready to fight. The construction of the remainder of the emplacement, magazine, etc., can go on at night, or when occasion offers. The work indicated should not take more than a day, under favorable conditions, but will, of course, vary greatly with the distance the gun has to be transported, the slope up which it has to be carried, and the amount of obstructions to be cleared away.

The plan shown is only intended to give a general idea of the type

adopted; changes may have to be made to suit varying conditions of ground and soil. Probably the only point in the construction of the emplacement that needs explanation is the construction of the magazine. In laying out the trace for this, it should be made slightly larger (though this will depend largely on the natural slope at which the soil will lie) than the ends of the roof timbers, as shown in large plan of magazine.

This area should be excavated to a depth of about 6 feet, then a distance of 2 feet on each side should be laid out toward the center; along this the trace of the magazine and bomb proof proper is laid off. This applies only to the sides. The excavation is then continued for 7 feet more. This produces a jog or berm, upon which the ends of the roof timbers rest, giving additional strength to the roof. The ground under the magazine should be cut away in the form of a shallow trough, sloping toward the drain. The drain is merely a ditch, the lower part of which is filled in with medium-sized stones, and the remainder filled in with the excavated earth. The drainage of the trench and magazine is the most serious question in constructing these emplacements. No rule can be laid down. The drain may have to be led to the front, rear, or either side, depending on the configuration of the ground. If led to the front it should be zigzag in trace, or at least have one turn in it to prevent shells from entering the magazine. Two inches of concrete (in proportion of 1 part sand to 1 part cement) should surround the magazine and bomb proof on all sides, 4 inches over the roof.

After the magazine is completed the roof is covered with earth up to the height of the top of the parapet, forming a traverse and giving additional protection to the magazine.

The same type of emplacement may be used for small rapid-fire guns, four or more guns may be mounted in it, and the width of the gun platform may be reduced to from 10 to 15 feet. The practice of placing more than two guns in one emplacement, when it can be avoided, is not advisable.

DEFENSES.

In formulating plans for the defense of isolated ports, such as coal-ing, supply, and repair sections, five considerations must be borne in mind: First, the importance of the port; second, the character of the vessels and guns by which it is likely to be attacked; third, the cost of construction, etc.; fourth, the guns available for the defense; fifth, the natural features of the port.

The following general conditions should be fulfilled in the arrangement of such defensive works:

First. They should be of sufficient strength to resist with success all ordinary means resorted to by an enemy in open assault.

Second. Be provided with suitable shelters to protect the men, the armament, and the magazines required for their defense against the destructive measures of the assailant.

Third. Be so planned that every point exterior to the defenses within cannon range is thoroughly swept by their fire.

Fourth. Have secure means of communication for the movement of men both within the defenses and to the exterior.

Fifth. Be provided with all such accessory defensive means as the natural features of the position itself may afford, to enable the garrison to dispute with energy the occupancy by the assailant of every point both within and exterior to the defenses.

General Abbot says:

The maxims of grand tactics applicable to coast defenses teach us the following:

(1) To provide for offensive movements of our own torpedo boats and of our armored ships, if any be present. This principle forbids the closure of channels by obstructions which can not be passed by our own vessels.

(2) To so place our land guns as to assure their mutual support and their most effective service against the enemy. Mutual support is important to prevent the overwhelming of our battery by the concentration of superior fire, which is always to be expected in a deliberate assault.

(3) To guard well the flanks by closing all unnecessary channels, and thus compel the enemy to make a direct attack or none at all.

(4) To provide means of offensive return against countermining operations in the absence of torpedo boats of our own. This is the true function of the automobile torpedo operated and directed from the shore.

Also, in general, an important seaport well defended implies: (1) The effective obstruction of all water approaches against the enemy, having free entrance and exit for our own vessels. (2) Protection for these obstructions and security for their operations and their flanking guns against escalade by boat parties. (3) So heavy a fire of modern high-power guns over all the approaches as to defy the most powerful fleet to operate in the channels leading to these auxiliary defenses. (4) A heavy flanking fire of medium and small projectiles over the obstructed zone. (5) The power of illuminating the obstructions by night, so far as this is physically possible. (6) Swarms of torpedo boats, which, safe behind the barrier, are always ready to sally out and carry the war into the enemy's fleet when favorable opportunity occurs.

Having considered generally the conditions to be fulfilled, we will discuss more particularly the subject of seacoast defenses of a semi-permanent character.

The low site for heavy guns is still advocated by some, principally on the grounds that they can thus generally be advanced nearer the target and get increased penetration, and also that from this position the impact of the projectile will be more nearly normal to the vertical armor. While this stand is well taken, the principal object of heavy

guns, certainly on board ship, being the racking or penetration of the vertical armor, and that the low site develops the best capabilities of the gun against vertical armor, it is difficult to see why we should bring our best against the best of the enemy when we can bring our best or nearly that against his weakest point, i. e., his deck. And why should we mount guns which, unless mounted on disappearing carriages or in turrets or protected by high parapets, can not be efficiently served owing to the top guns of a fleet?

It would appear only reasonable then to place the lowest limit of site at that of the top guns of a ship. An eminent artillery authority, in the course of a series of lectures at the War College, limited the heights of sites of batteries to between about 60 feet (I have not the exact figures by me), or the height of top guns, and 270 feet, at which height he had calculated that the angle of fall of the projectile at the target at effective range would be greater than 35 degrees, and that at a greater angle of fall the projectile would either glance or be broken up.

While not wishing in the least to controvert this limitation of the maximum height of sites, it would seem to be directing our main efforts to attacking the enemy at his strongest point, i. e., his vertical armor, and it is evident from the above figures that the higher we raise our gun the more nearly normal will be the impact of the projectile to the deck or horizontal armor.

My limited study of the subject has most strongly inclined me to favor high sites for all heavy and medium caliber guns intended to be used against armored vessels, the higher the better—with limitations—the principal ones being the distance of the site from the target and the "dead zone." The "dead zone," it may be explained, is the space or distance between a vertical line dropped from the gun and the point where the projectile will strike when the gun has its maximum practical depression; or, the base of a right-angled triangle, with the gun at the vertex.

The advantages of a high site are plunging fire against the weakest part of a vessel; increased striking energy of our own and decreased striking energy of the enemy's projectile due to gravity; increased size of the target, and better protection for guns and personnel, though this is apt to be overestimated. Another most important consideration is that a high site limits greatly the closeness of range at which an enemy can engage, owing to the limitation of the elevation of guns mounted on board ship. Increased range means decreased accuracy, and as all experience shows that there must be a direct hit of gun or carriage to put it out of action, the importance of high sites from this consideration alone is obvious.

It would seem apparent, then, that the height of a site is mainly limited by the two considerations mentioned, i. e., range and "dead zone,"

barring natural or mechanical difficulties in emplacing or mounting the guns. The one would force itself on the attention in selecting sites; the other may be roughly calculated by allowing 70 yards for each 25 feet of elevation—this for 7 degrees depression of the gun.

The high site is especially important in the type of defenses that we are considering, as only medium caliber guns are mounted, which would be powerless against the vertical armor of armored vessels, but would be very effective against the deck armor.

The low site is recommended for small caliber and machine guns, which are intended solely to be used for the protection of the mine field or to prevent small boats or torpedo boats from passing the obstructions. Here, as the question of penetration does not enter, the importance of a large danger zone becomes of the utmost importance; and as such attempts at countermining or entering the harbor are only to be expected at night, the protection of the personnel does not enter so largely into the question, but the batteries should be thoroughly masked from sight by daylight.

The position of these batteries should be low down, slightly inside of the obstructions they are intended to cover, and on either flank to get an enfilading fire.

Machine guns should be mobile, mounted on either wheels or tripods, placed ordinarily on the flanks of both main and auxiliary batteries, and should take these positions at drill.

In mounting heavy guns they should be mounted singly or in groups of from 2 to 4; if in the latter, the individual guns should be placed far enough apart not to have two guns and their crews disabled by a shell bursting them, and they should be separated by heavy traverses. The number of guns in a group must be largely determined by the terrain, the means of communication, and the number of guns available. It is not considered advisable to place more than three heavy guns in a group; it is offering too tempting a target to the enemy, and enables him to direct a convergent fire on us while forcing a diverging fire on our batteries. By scattering the guns, mounting them singly or in pairs, we not only gain the advantage of convergent fire, but in attacking a single ship we are able to force the ship to fight more or less at a disadvantage in one or more directions.

The number of guns in a group must be not only governed by the considerations mentioned above, but by the probable fire discipline of the forces upon which will depend the control of the fire. It is undoubtedly true that concentration of guns conduces to better fire control and to more moral effect on the enemy, but it is a rule which works both ways, so that when the terrain and other circumstances will permit, it is considered best to mount the heavy guns in pairs, or even singly at certain points.

The machine guns should be mounted on a portable tripod or

wheeled mount, and be arranged in such manner as to make it possible to move them promptly to any part of the defenses. They should be assigned to definite places along the front of the defenses, with cover provided, and they should be habitually worked from these points at drill. It is hardly necessary to say that all batteries should be masked as much as possible. Properly masked batteries using smokeless powder are almost impossible to locate in daylight, and heavy guns should be cautious in taking part in repelling an attack at night, as such attack may be made with only a light force for the purpose of locating the main defenses.

The character and amount of the protection and the invisibility given the heavy guns will depend entirely on the nature of the terrain in the immediate vicinity, and on the character of the soil or ground on the selected site. This refers almost entirely to hasty defenses, or where time, labor, material, or money is not available to construct suitable protection and cover, and it is impossible to elaborate any definite plans of defenses unless an accurate topographical survey is made of the intended site and its vicinity. This should show the nature of the soil or rock, whether wooded or open, the height of selected site, nature of land in front and in rear, whether on side of slope or on crest, points commanding it with direction and distances. In a word, it should be a complete topographical and geological map not only of the site itself, but of an area included within the range of its guns. The hydrographic survey should show the depth of the water within the range of the guns of the battery, the rise and fall of the tide, direction and strength of currents, and nature of bottom and shore line, together with any particular knowledge which it may be necessary or to the advantage of the land defenses to possess.

As the guns are to be mounted in barbette or completely exposed so far as a frontal fire is concerned, the guns themselves must take their chances of being put out of action by a direct hit from a moderately heavy projectile. How small this chance is, if properly masked and separated, the bombardments of the batteries at Alexandria and Santiago show.

The gun's crew under any circumstances must be protected by shields from rapid-fire projectiles and pieces of shell exploding in front of them. There is a prejudice in some quarters against shields, but it is more theoretical than practical. There is little doubt that the crew of a gun unprotected by a shield will be swept away by the fire of rapid-fire and machine guns or shrapnel. It is true that if a shield is struck by a heavy projectile the gun's crew will be annihilated, but even a shield is a small target for a heavy gun; by surrendering them we open ourselves to the certainty of having the gun's crews swept away by rapid-fire and machine guns, against the very remote possibility of such an event by retaining them. Aside from this is the

moral effect. We will get much better service if the pointers have only to dodge large projectiles.

We will consider then that the heavy guns are to be mounted with no more protection than their shields, and turn our attention to the more important part, the protection of those engaged in the passing of ammunition, etc., and the ammunition itself.

There may be isolated instances where these can be given little or no protection, as where it is necessary to mount the guns on a rocky ledge, but even here it will almost always be found possible to make use of some unevenness in the ledge, or at least gain protection from sight by bushes, etc.

Probably one of the best means of protection at our disposition, and it is one of the best, will be earth and sand. This may be helped out, if the material is available, by concrete or stone; the resistance to penetration of the former being twice and the latter three times that of earth and sand.

For the protection of the personnel of a battery, we have two methods at our disposal: First, the erection of a wall of sufficient thickness and height to give the necessary protection; second, a system of sunken trenches and gun pits.

It is estimated that 70 feet of earth will equal one and a half times penetration of the heaviest projectile, but this estimate is considered excessive, and the custom abroad is to make the defenses from 33 to 40 feet in thickness. This may be considerably reduced by a combination of earth and stone or concrete.

The theoretical penetration of an 8-inch projectile having a striking velocity of 1,800 feet is, in heavy clay 43 feet, sand mixed with gravel 25.5 feet, granite 5.1 feet; for a 6-inch projectile with the same striking velocity, heavy clay 30.6 feet, sand, etc., 18.1 feet, granite 3.6 feet.

The actual penetration of a 9-inch projectile at the muzzle is earth 40 feet, concrete or brick 12 feet, stone 8 feet; of a 6-inch projectile with a striking velocity of 1,800 feet, earth (mixture of clay, chalk, stones, and brick) 12.3 feet, earth 15 feet, sand 12 feet. A rule deduced by Capt. Orde Brown of the British army, which is said to give quite accurate results, is one and one-half calibers in wrought iron for each 1,000 feet of striking velocity. Thus if we know the relative resistances of various substances to that of wrought iron, and the shortest range at which the battery can be engaged, it is a simple matter to compute the maximum thickness of parapet required.

For ordinary sandy loam this may be taken as about 30 feet, though if the soil is at all clayey this should be increased by at least one-third. The resistance to penetration may be increased by mixing the earth with sand and gravel, or by making a core or rubble, or by constructing the interior revetment of granite or concrete. The greater the thick-

ness of the latter the better the protection, but this will be practically limited by the cost or the amount of the material available. Three feet in thickness will in most cases do, and allow us to make our interior revetment almost vertical. Care must be taken not to carry this up too near the level of the crest of the parapet, as any heavy projectile will shear this, and, striking the concrete or stone, its destructive effect will be greatly increased. A safe rule will be to have the line joining the tangent to these at an inclination of 30 feet to the horizontal. This angle may be decreased as the height of the site increases.

The height of the parapet is the next subject which should be considered. It is self-evident that the higher the parapet the greater the protected zone in rear of it. This height is limited, however, by a number of practical considerations: The cost; time and difficulty of construction; the angle which the material will allow the revetment to be given; and the size of the target presented. Calculations show that a parapet 10 feet high will give a protected zone of 16 feet in rear of the crests for objects 6 feet in height from a fire the angle of fall of which is 20 degrees. One 8 feet will have a protected zone of 12 feet. This is calculated for both gun and target being in the same horizontal plane. This protected zone will, of course, increase with the elevation of the battery site, though the added protection from elevation of site is commonly enormously overestimated. Major Knight, United States engineer, says "that the additional protection arising from the tabulated elevation of sites * * * is practically nothing for nondisappearing barbette guns, and that moderated elevations of site result in dead zones, which should not be disregarded."

The angle of fall taken is excessive, and will only obtain when heavy guns are used, and fire at long ranges. Probably the average angle of fall due to ranges at which ships will engage forts will not be greater than 6 or 7 degrees, or about 3,500 yards for Q. F. guns, and 2,500 yards for rapid-fire guns. It is impossible to give any relative data on the subject, as it depends entirely on the range at which ships will engage forts. There is little doubt at what range ships should engage forts—from 500 to 1,000 yards—or, in other words, at such distance that every shot will hit; in this way only can the ship offset, by the superior number of its guns and rapidity of fire, the weight and more accurate fire of the fort, the latter due to stationary platform, a better target, and an accurate knowledge of the range. But it is more than probable that the range will be determined by the distance of mine fields from the fort—this may be taken as an average of from 2,000 to 3,500 yards—and until these mines are destroyed it is improbable that any fleet will attempt to run the forts.

We may therefore assume that the crest of the parapet should be from 8 to 10 feet above the terreplein. So far as protection only is concerned, it would seem that gun pits connected by a system of

trenches would be almost ideal, having also the great advantage of offering little or no target to the enemy.

MAGAZINES.

The magazine for powder should, when practicable, be placed below the surface of the ground, and should never be exposed to the direct fire of the enemy. The interior of the magazines, the floors, and the doors are built with a view to security from fire, and to preserve the powder from dampness. A good system of drainage around the foundations should, if possible, be secured. No iron or steel fastenings or sheeting is allowed. The magazines should, if possible, be furnished with natural protection, and care must be taken to dig the ditches between the gun platforms and magazines sufficiently deep to permit the ammunition carriers to move along them with comfort. The ditches should be protected with bomb-proof cover and should be properly ventilated.

In this connection the general subject of communication between the various parts of the defenses should receive attention.

In small works, such as we are considering and in which the garrisons are calculated to make only a strictly passive defense, communication of just sufficient dimensions for the passage of the troops from point to point will serve every purpose, and can be more easily barricaded and otherwise defended.

All communications, to serve properly their ends, should fulfill the following conditions:

(1) They should never, from their position, compromise the safety of the enceintes. Frequent instances could be cited of works which have been surprised by an enemy obtaining possession of the gates. Therefore, too many precautions can not be taken to secure the prompt outlet from the body of the place from similar attempts.

(2) They should admit of a convenient circulation of the besieged. To subserve this purpose, the dimensions, slopes, etc., of the posterns, ramps, and similar works should be convenient for the service to which they are applied, and they should be placed in such positions as lead directly to the point to be arrived at.

(3) The position chosen for any communication should be such that when an enemy gets possession of it he may obtain no advantage by it. To be useless to an enemy, the communication in his possession should offer no shelter for his works, nor enable him to carry them on with more ease. This end will be obtained by placing the communication in a position to be enfiladed by the fire of the works in their rear, and so arranging them as to preserve the counterscarp wall unbroken.

(4) The communication should be covered from every point where an enemy might establish himself during the whole period that they

can be of service to the besieged, and they should be swept by the fire of the enceintes. With these precautions an enemy might cut off all communications from the enceinte with the outer works, and in case of retreat the troops could not derive any assistance from the enceinte if he attempted to press upon them.

(5) They should be placed so as not to compromise the retreat of the troops. This is effected by placing the communications in the reenterings, which are the most accurate points, as an enemy to arrive at them will have to brave a powerful column of flank fire. Barriers, gates, and movable bridges of timber should be placed at suitable points and cut off one communication from another, and thus arrest the progress of the pursuing enemy.

(6) Each work should be independent of every communication except that one designed for its particular use. If this condition be not fulfilled, a work may sometimes be captured by an enemy obtaining possession of a communication passing through it, but designed for the service of some other work.

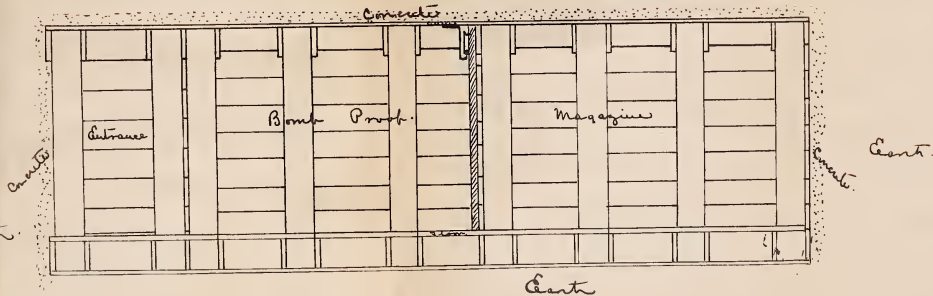
PERSONNEL.

In connection with the general subject of semipermanent fortifications the question of the number of men necessary to properly man them may be deemed to be pertinent. It is presumed that in most cases the heaviest guns which would be taken from ships and mounted on shore would be the 6-inch B. L. R., and in this connection this will be the heaviest gun considered. It appears, from the various sources of information, that the number of men required for the various guns seems to be rather a variable factor. For a 6-inch breech-loading rifle, in the Navy, mounted on the deck of a ship, a crew of 12 men is supplied, which crew, in case of necessity, can man the guns on both sides, leaving but 6 men necessary to handle a 6-inch gun. The Army, however, in support of its reorganization bill, submitted a memorandum to Congress showing the number of pieces of ordnance for the fortress artillery mounted, and the number of men required to man them in time of peace, and in that table it is found for a 6-inch gun the Army provides 19 men, thus showing a difference of 7 men in favor of the Army. It is not difficult to decide between these two, but from practical experience it is recognized that 6 men can very easily serve the gun properly, the number of additional men being largely dependent upon the location of the magazines. If, in a semipermanent fortification like that under consideration, the magazine is placed close to the gun proper, two or three men would be ample to provide the necessary ammunition. If, however, the magazine is located remote from the guns, the number of ammunition bearers must be proportionately increased; each particular case must be decided by the commander in accordance with the then existing circumstances. With these general provisions in view it may be well

Section (vertical) 2nd 5th Magazine
200 rounds

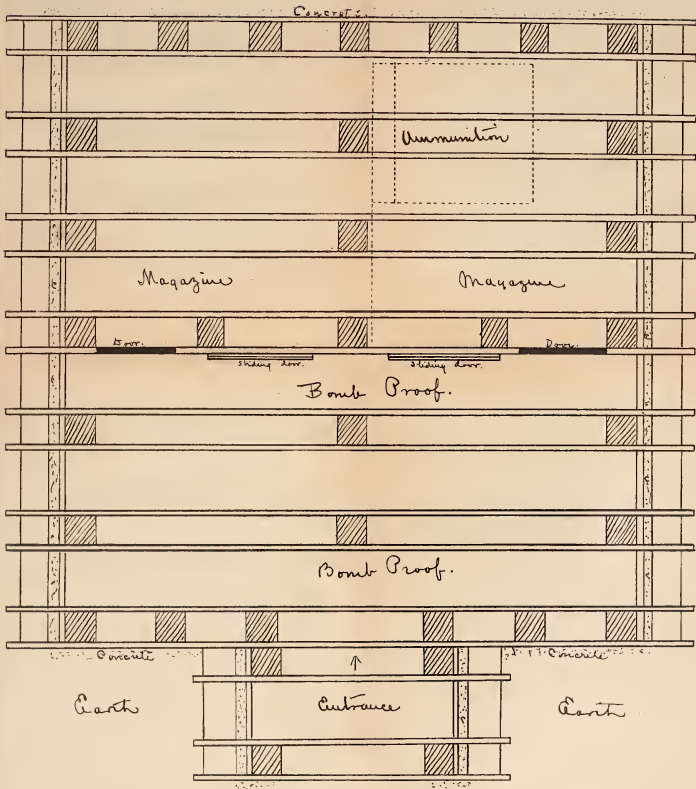
Earth

Concrete

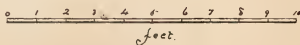


Scale 1" = 3'

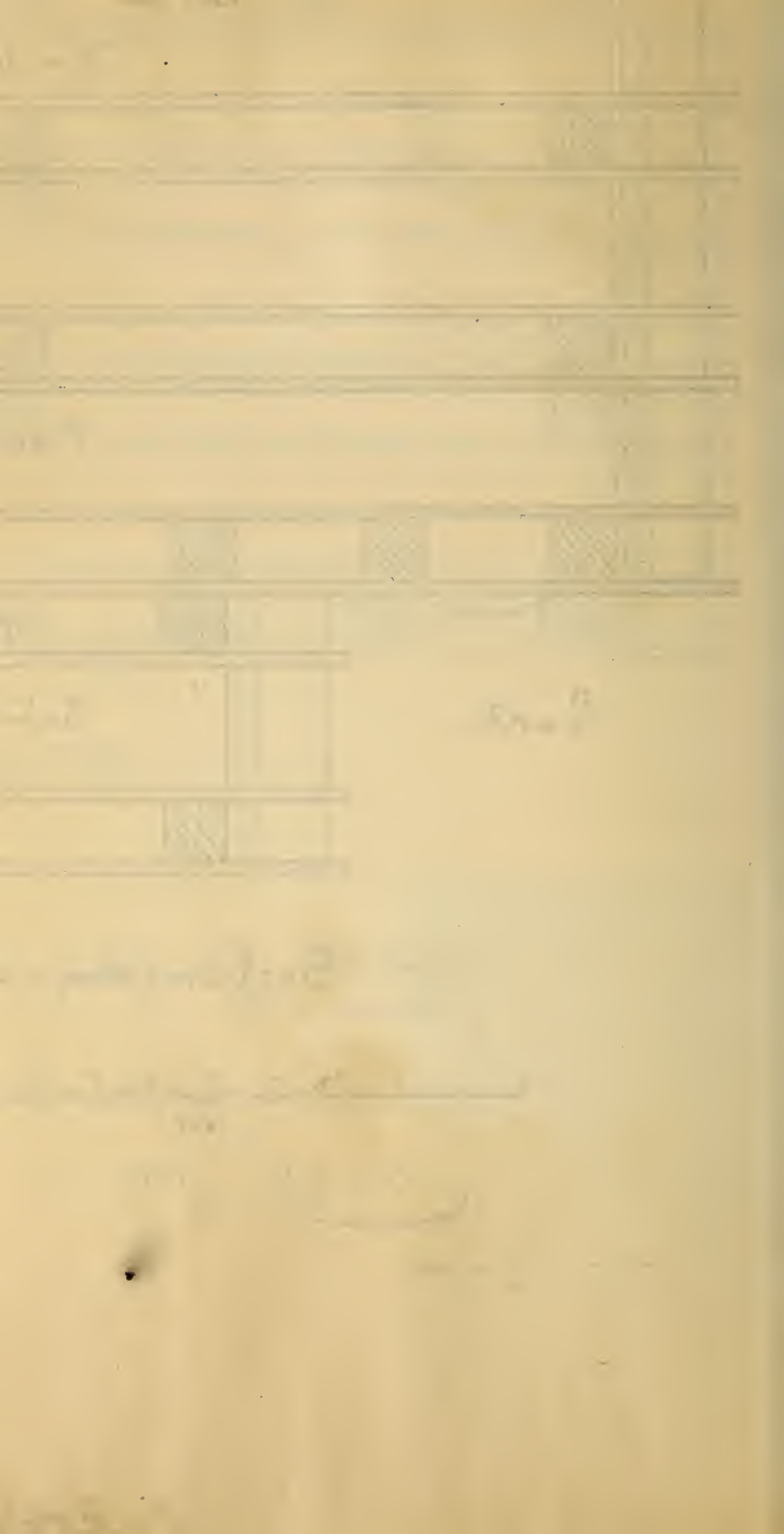
Earth.



Section (horizontal) 2 bu. 5ⁱⁿ Magazine
200 rounds.

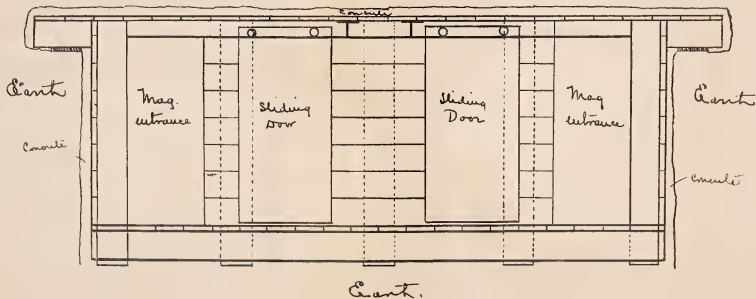


1/2" = 1 ft. 1902.



Cross section
5th Magazine (through bulkhead).
Scale 1" = 3'

Earth



to give the number of men laid down for the various guns in the Navy Drill Book, and also those laid down in the memorandum above referred to, prepared by the artillery, for coast fortifications:

	Men.	
	Navy.	Army.
8-inch breech-loading rifle.....	12	29
6-inch breech-loading rifle.....	12	19
5-inch breech-loading rifle.....	8	14
4-inch breech-loading rifle.....	8	14
3-inch breech-loading rifle.....	4	13
6-pounder.....	4	8
1 and 3 pounders.....	3	(a)

^a Not provided for.

It may be proper to state that in the above number of men mentioned in the memorandum for the Army the details consist of a gun commander, a gunner, the breech detail, the charge detail, ammunition sergeant, cartridge detail, shell-room detail, hoist detail, platform detail, telephone men, telegraph men, position-finder men, and range-finder men. We shall later consider the various range finders. Of these the Lewis depression finder, type B, would be the one which would be used in the Navy in equipping semipermanent fortifications. One of these range finders should be placed near each two large guns, and one man is ample to properly handle same.

Considering an expeditionary force of 1,000 men in the semi-permanent fortifications it is presumed that two, or probably three, searchlights would be all that would be deemed necessary. In making the detail for the searchlights two men to handle each light would be all that would be required. Of course, in connection with the subject of these searchlights consideration must be given to a detail of men in the dynamo room, which would be required to furnish the current. For a plant large enough for three searchlights eight men would be ample for all purposes. To construct telegraph and telephone lines in the fortification proper, and to connect same with the base, probably eight or nine men would be required.

Angle of Fall I. V. 2,000 feet (nearest degree).

[illegible]

7-degree angle of fall:

8-inch	5,000
6-inch	4,400
5-inch	4,000
4-inch	3,300
6-pounder	3,000
3-pounder	2,900
1-pounder	1,900
47 mm.....	1,800
37 mm.....	1,600

20-degree angle of fall:

8-inch	9,000
6-inch	8,000
5-inch	7,500
4-inch	7,000
6-pounder	5,900
3-pounder	5,200
1-pounder	3,000
47 mm.....	3,100
37 mm.....	3,000

To completely protect a man 6 feet tall standing 20 feet in rear of the crest of the parapet, the crest must be 8.3 feet for a fall of 7 feet, and 13.2 feet for a fall of 20 feet. A parapet 10 feet high will protect the man 12 feet in rear of it from a 20-foot fall.

Dead zone.

[A rough estimate of "dead zone" may be obtained by adding 68 yards for 7 feet and 60 yards for 8 feet depression for each 25 feet above sea level.]

Height, firing point.	Depression.		Height, firing point.	Depression.	
	7 yards.	8 yards.		7 yards.	8 yards.
<i>Feet.</i>			<i>Feet.</i>		
25	68	60	250	678	593
50	137	120	275	746	652
75	203	178	300	814	712
100	271	238	325	882	771
125	339	300	350	950	830
150	407	356	375	1,018	889
175	475	415	400	1,086	948
200	543	475	450	1,222	1,067
225	611	534	500	1,357	1,186

Material, 5-inch magazine.

Top:

Pine or spruce—

12 by 12 inches, 8 feet 2 inches long (uprights)	pieces..	34
Rough, 2 by 12 inches, 26 feet long.....	do.....	11
Rough, 2 by 12 inches, 22 feet long.....	do.....	14

Floor:

Pine or spruce—

Rough, 2 by 12 inches, 22 feet long.....	do.....	18
Rough, 2 by 12 inches, 26 feet long.....	do.....	2

Sides:

Pine or spruce—

Rough, 2 by 12 inches, 22 feet long.....pieces.. 18

Rough, 2 by 12 inches, 22 feet long.....do.... 5

Ends, pine or spruce, rough, 2 by 12 inches, 20 feet long.....do.... 18

Floor and top joists, pine or spruce, rough, 2 by 12 inches, 24 feet long.....do.... 31

Bearing pieces, pine or spruce, rough, 2 by 12 inches, 22 feet long.....do.... 6

Bracing material:

Pine or spruce, planed one side, 1 by 12 inches, 22 feet long.....do.... 41

Overhead rails and fittings for sliding doors, doors to be about 3 feet
wide, travel about 4 feet..... 3

Padlocks and hasps, for magazine and bombproof doors..... 3

Box lanterns, with reflectors, to burn lard or olive oil..... 3

4-inch drain pipe, S shape.....pieces.. 2

4-inch drain pipe.....feet.. 30

Hoods to fit same..... 2

6-inch drain pipe, S shape.....pieces.. 3

Drain pipe, 6-inch diameter.....feet.. 50

Hoods to fit same..... 3

Cement.....barrels.. 9

Pine boards, tongue and grooved, 1 by 4 inches.....running feet.. 1,380

Spikes, 7 inches long.....pounds.. 400

Nails, 5 inches long.....do.... 125

Nails, 4 inches long.....do.... 65

Nails, 2½ inches long.....do.... 20

All timber should be lightly creosoted, or creosote furnished for that purpose.

MINIMUM ALLOWANCE TENTAGE, EQUIPAGE, ETC., ARMY.

Dimensions of tents.—Common tent, 8½ by 7 feet; wall tent, 9 by 9 feet; conical tent, 16½ feet diameter; hospital tent, 14 by 14½ feet.*Headquarters of a brigade.*—One wall tent for commanding general, 1 wall tent for every 2 officers of his staff, 2 wall tents for field and staff above rank of captain, 1 wall tent for other staff officers and captains, 1 wall tent for every 2 subalterns of companies, 1 common tent to every 3 enlisted men, 1 conical tent to every 20 foot or 17 mounted men, 1 common tent for each company for subsistence stores, 1 hospital tent for each corps, division, or brigade headquarters, 1 common tent for each regimental headquarters.*Tentage, regimental hospital.*—Four hospital tents (2 to be used as wards, 1 as a dispensary and storage, and 1 for the mess); 2 common tents for noncommissioned officers; 3 common tents for privates; 1 common tent for cook tent.*For each ambulance company.*—Seventeen common tents for privates; 2 common tents for noncommissioned officers.*Hand litters and slings to be furnished by the quartermaster's department.*—One for each company; 2 for each ambulance.*Equipage.*—One ax and 1 hatchet each for a general officer and all officers above the rank of lieutenant; 1 of each for every 2 subalterns; 1 ax and 1 hatchet for every 15 enlisted men; 2 spades, 2 pickaxes, 2 camp kettles, and 5 mess pans for every 15 men.

MINIMUM ALLOWANCE OF WAGONS, AMBULANCES, HORSES, ETC.

Headquarters of a brigade.—Two wagons for baggage, etc., or 5 pack mules; 1 2-horse spring wagon; 2 extra saddle horses for contingent wants.*Allowance of transportation for a regiment of infantry.*—Twenty-five wagons.

Supplies to be carried in wagons per company.—Ten days' field rations per man; 100 rounds of ammunition per soldier; 250 pounds of officers' baggage and supplies; tentage; grain for animals; utensils for each company mess, not to exceed 350 pounds for each company; horseshoes, nails, tools, and medicines for cavalry horses, not to exceed 300 pounds; to each soldier or civilian employee (compactly rolled in one piece of shelter tent) 1 blanket, 1 poncho, and 1 extra suit of under-garments.

Weights, one company.

	Pounds.
Field rations, ten days.....	3,858
Ammunition, 100 rounds	769
Officers' baggage, etc	250
Tentage (7 conical tents per company)	854
Grain for animals	720
Utensils for each company mess	350
Horseshoes, nails, etc.....	300
Soldiers' baggage (1 blanket, 1 poncho, 1 piece shelter tent, 1 suit underclothes)	1,761
Total	8,862

Horses for mounts.—To each regiment of infantry, hospital steward, 1; privates, 1. To each brigade headquarters, hospital steward, 1; privates, 1. To each division ambulance company, hospital stewards, 7; assistant hospital stewards, 3; privates, 12. To each division field hospital, hospital stewards, 2; assistant hospital stewards, 2; privates, 6.

Wheel transportation.—One ambulance to 400 men of effective force, 1 4-horse wagon to 600 men of effective force, 1 4-horse wagon to each brigade; 2 4-mule wagons will be furnished for each hospital.

Transportation allowed a regiment.—Twenty-five 6-mule wagons, 2 horses for hospital corps, 3 ambulances, 2 4-mule wagons, or a total of 170 mules and 2 horses.

In addition to the public animals, there will be allowed about 18 private horses for field and staff.

Dimensions or capacities of standard railroad cars.—Pullman palace car, 12 sections and a drawing room; tourist sleeping car, 10 sections and a drawing room; freight car (box), length 34 to 35 feet, capacity 40,000 to 60,000 pounds; flat car, length 34 to 36 feet, width 8 feet 6 inches; gondola or coal car, length 34 to 36 feet, width 8 feet 5 inches; palace stock car, length 36 to 40 feet, capacity 16 to 20 head; improved stock car, length 36 feet, capacity 20 to 24 head; ordinary stock car, length 30 to 34 feet, capacity 16 to 20 head.

Transportation of a regiment.—44 officers, 3 Pullman cars; 1,235 enlisted men, 412 sections in tourist sleeper, 3 men to section; 17 horses, 1 palace stock car; 40 mules, 2 improved stock cars; 10 wagons, 1 flat and 1 box car; freight, 8 box cars.

Order of loading on cars.—Officers' baggage, enlisted men's baggage, ammunition, rations, hospital stores, tentage.

Weights of wagons and spare parts.—Army wagon, 1,950 pounds; escort wagon, 1,550 pounds; hospital ambulance, 1,490 pounds; farm wagon, 1,000 to 1,300 pounds; Dougherty wagon, 1,375 pounds. The weight to be carried by a 6-mule wagon not to exceed 4,000 pounds; the weight to be carried by a 4-mule wagon not to exceed 3,000 pounds, and, if possible, should be less per wagon.

THE GUN DETACHMENT.

[Taken from "The fighting unit in coast defense," Military Service Institution, November, 1897, No. 90. By Lieutenant Weaver, Second Artillery.]

GUN DETACHMENT.

- 1 sergeant, chief of piece.
- 1 corporal, gunner.
- 10 privates, guns crew.
- 2 privates, supernumeraries.

For two reliefs these numbers will become 2 sergeants, 2 corporals, and 24 privates.

POWDER DETACHMENT.

- 1 sergeant, chief of detachment, in charge of whole service.
- 1 corporal, in charge of magazine service.
- 4 privates, to assist corporal in magazine.
- 8 privates, powder carriers, to transport cartridges to gun.
- 2 privates, supernumeraries.

For two reliefs there would be required 2 sergeants, 2 corporals, and 28 privates.

PROJECTILE DETACHMENT.

- 1 sergeant, chief of detachment, in charge of whole service.
- 1 corporal, in charge of preparation of projectiles.
- 8 privates to assist corporal at main projectile supply.
- 16 privates, projectile carriers, to transport projectiles to gun.

For two reliefs there would be required, 2 sergeants, 2 corporals, and 52 privates.

Combining the above, there would be required for the complete service of a heavy gun:

- 6 sergeants.
- 6 corporals.
- 104 privates.

This allows for two reliefs.

The general control and direction of all operations connected with the service of one large gun should be intrusted to a lieutenant. The command and direction of the fire of two large guns should be assigned to a captain. The complement of officers, noncommissioned officers, and men for a group of two large guns would be, therefore:

- 1 captain.
- 2 lieutenants.
- 12 sergeants.
- 12 corporals.
- 208 privates.

The same principles may be applied in determining the number required for the service of the small-caliber guns.

Each 6-inch rapid fire gun will require for its complete service:

- 1 corporal, to supervise the supply of ammunition, and aim and fire the gun.
- 1 private to manipulate the breechblock.
- 1 private to push powder and shot home.
- 4 privates, projectile carriers, two squads of two men each.
- 2 privates, supernumeraries.

To every three pieces a sergeant should be assigned for purposes of supervision and direction.

Three pieces should constitute a "group," and may be considered as the number that would be fought together on the fighting line; it would be the natural command of a lieutenant, and so considered. The 6-inch rapid fire guns would, therefore, be divided into two distinct groups, each under the command of a lieutenant. Both groups, together with those of the 4-inch rapid-fire guns referred to below, would be under the general command and control of a captain.

For two reliefs the 6-inch rapid-fire guns would require 2 lieutenants (officers not changed with relief), 4 sergeants, 12 corporals, 96 privates.

Each 4 in rapid-fire gun would require for its service:

- 1 corporal, to supervise ammunition, supply, and loading, and to aim and fire the gun.
- 2 privates, ammunition carriers.
- 1 private to load.
- 1 private supernumerary.

To every four pieces a sergeant should be assigned for the purpose of supervision and direction.

A "group" with these guns should consist of four guns, and, as with the 6-inch guns, should constitute the command of a lieutenant.

The complement for two reliefs of all eight 4-inch guns would be 2 lieutenants, 4 sergeants, 16 corporals, and 64 privates.

Recapitulating the services of all the rapid-fire guns would require the following officers, noncommissioned officers, and men:

- 1 captain.
- 4 lieutenants.
- 8 sergeants.
- 28 corporals.
- 160 privates.

The service of each machine gun would require the following personnel:

- 1 corporal, to supervise the supply of ammunition, the loading, and to aim and fire the gun.
- 1 private, to feed ammunition.
- 1 private, to carry ammunition.
- 2 privates, supernumeraries.

A sergeant should be assigned to every two guns.

Every four guns should constitute a "group," with a lieutenant to command it and direct its fire in action.

Only one relief need be provided for these light guns.

Assuming that the guns will be fought in groups of four, each group being under the command of a lieutenant, and that the number of machine guns (twelve) will be under the general command and direction of a captain, the complement required for the service will be:

- 1 captain.
- 3 lieutenants.
- 6 sergeants.
- 12 corporals.
- 48 privates.

The above is given more for the excellent ideas it contains than as rules to be followed.

It is believed that the proper minimum allowance for each gun in improvised defenses should be as follows: Six-inch, 20 men—6 at the gun, the remainder ammunition carriers, divided into two reliefs; 4 and 5 inch guns, 18 men—4 at gun and remainder divided into two reliefs; 3-inch high-power gun, 11 men—3 at gun, remainder ammunition carriers, divided into two reliefs; 6-pounders and smaller rapid-fire and machine guns, 8 men—3 at gun and remainder ammunition carriers. These are the number of men that should actually be at the battery. Allowance must be made for sick, daily duty men, cooks, guards, etc., and each battery should have an infantry support, the size of which would depend largely upon the liability of the battery to attack by landing parties.

FIELD TELEGRAPH AND TELEPHONE EQUIPMENT FOR LANDING PARTIES.

The question of the equipments for field telegraph is dependent upon whether the line is to be a semipermanent or permanent one. If the former, which is supposed to include parties operating rapidly from 10 to 20 miles from place of landing, the most rapid and expeditious method would consist of an adequate supply of light insulated wire. If, however, a party is to make a prolonged stay on shore, and to operate at a greater distance than 20 miles from the place of landing, a semipermanent line of No. 14 galvanized-iron wire for lances will best serve the purposes.

The question of the military lance-line construction in connection with a landing party should receive consideration in the organization of the party, and a squad for this purpose should consist of 1 sergeant, 1 rod man, and 2 reel men, all being under command of a commissioned officer.

The sergeant, if practicable, should be one who has had experience in lance construction, as it will be his duty to lay out the course and to perform such other duties as are generally performed by a surveyor. His judgment must be depended upon in selecting the best line to be followed, and in case of a change of direction the proper angle for such change. It is, of course, always preferable, especially in a hurriedly constructed line, to have as few changes of direction as possible. In laying out a line the sergeant should stand by the stake at the angle and carefully direct its new course. It is his duty to send the rod man in the right direction and properly align him as he advances, directing him to place a stake at every 50 paces.

The rod man should carry a small crowbar and, for use in sandy soil, a sharp stick about 5 feet long. He should also carry a haversack containing small wooden stakes, or marking pins made of iron wire and painted white. The rod man will use the bar or stake in the same manner as a surveyor's rod. The rod man having advanced 50 paces from the sergeant, turns and faces him and is aligned on the sergeant, who motions to the right or left with his hand. When the alignment is satisfactory to the sergeant the rod man drops his bar straight down, making a hole in which he places a marking pin; he then makes an about face and proceeds 50 paces, when the operation is repeated. In case the end of any one of the 50 paces should terminate in the middle of a road, the stake should be placed on that side

of the road which makes less than 50 paces. The reel man should carefully watch the reel while the wire is unreeling from a wagon, and in case of places impassable for the wagon they should carry, or what is technically known as "buck." The reel men should follow as closely as possible after the rod man, in order that the wire may be rapidly laid. Care must be taken by the reel men to see that the reel does not unwind too rapidly, as the wire will thus become tangled and cause trouble.

The lance-truck assistant should accompany the truck and deposit a pole with insulator attachment at each marking stake. In order to secure the best results, every fifth insulator should be a tie or rams-horn insulator. Great care must be taken in holding the insulators, to prevent their being broken. The bar men each carry a crowbar, make a hole at each marking stake, put the wire on the insulator, plant the pole, and then tramp the ground thoroughly around it. In sandy soil the poles should be planted at least 20 inches, while in hard ground 15 inches will suffice. The two bar men will handle alternate poles, but when a tie or rams-horn insulator is reached they will work together, the one pulling the wire taut, the other attaching it to the insulator. It is also a part of the duties of these men to preserve the wire marking pins and send them forward to the rod men as frequently as possible. In case very hard soil is encountered, and in order to prevent delay, the rod men should be reinforced.

The line men should carry a small coil of wire, ax, porcelain insulators, pliers, and climbers. They should follow the bar men and adjust a guy to each lance at the points where the direction is changed. When a change of direction is greater than 30 degrees the porcelain insulator should be wired to the top of the pole instead of the rubber one. The porcelain insulator is wired to the pole so that the line wire will run in the groove of the insulator. In case a rod is crossed where there is a lead of permanent poles, a porcelain insulator should be placed on the pole a few feet higher than the tops of the lance poles; this is done to keep the wire from falling into the road in case of accident to the line, and also to protect the wire from extraordinarily high vehicles.

The telegraph kit (buzzer) consists of an arrangement in a handily transported box, but requires the services of a skilled operator at each station. This kit, by reason of the high potentiality of its current, may in an emergency be used for telegraphing over naked wire laid on the ground. It is the most reliable means for establishing and maintaining the wire connection at present in use. The telegraph kit used by the Signal Corps of the Army can be purchased from Foote, Pierson & Co., New York, at \$22.

The field telephone equipment is a light, compact arrangement of a battery, telephone receiver, and collector, and is readily operated by

anyone, and requires no previous training of the operator. It is not liable to get out of order, is easily repaired, and, except that it does not preserve messages, is very satisfactory for field use. The only adjustment which is necessary is to connect the wires to the thumb screws on the machine at the station and carry the wires along and connect them with the machine at the other station, and the circuit is then complete. This telephone kit can be purchased from Foote Pierson & Co. at a cost of \$41. With this kit either the light insulated wire or the No. 14 galvanized-iron wire can be used.

In connection with the subject of military lance-line construction the following suggestions are pertinent:

SUGGESTIONS.

It will often be found necessary to increase the force of line men with several additional men to clear away branches, brush, and vines from the wire. Machetes are the best tools for this work and should be obtained if possible.

Much time may be lost in cutting down trees or in climbing to cut away branches. A light pole with a crotch at the end and long enough to reach above the wire can be used to good advantage. Put the interfering branches in the crotch and twist the pole around until the branches break off.

The sergeant should take care to run the line near a permanent pole if crossing the road with a lead, so the wire can be secured to it.

The kind of marking stakes used will depend entirely on the nature of the ground over which the line is to be passed. In tall grass, wire marking pins will not do, and sticks about 3 feet long will be required.

In crossing a road which is on a ridge with the slope down on each side, a pole should be placed on each side of the road with tie insulators on each, to prevent the line from sagging too low in the road, also to prevent the wire from falling in case of accident to the line on either side.

In crossing much-traveled roads, roads in a sandy locality, or roads used by unusually high vehicles, the wires should be raised higher by binding two lances together with wire to make the pole about 8 feet longer.

Where there is plenty of construction material on hand, a line can be more economically and rapidly constructed and easier taken up if it runs along the side of a wagon trail or road than to "buck" the reel across country, carry the lances, and cut away branches in order to shorten the line.

In clear country the rodman can continue marking the line in the same direction without assistance from the sergeant by lining himself in with two marking pins in the rear.

It is difficult to construct a line in a heavy fog or smoke unless the rodman can see the last two poles erected and line in on them. If not, large white signal flags may be advantageously used.

The sections of a construction party should work as near together as possible, as it often occurs that the linemen or rodmen will run out of material, and, if far apart, much delay is occasioned in bringing it up.

The officer in charge of the squad should arrange the number of men for each section of the construction party according to the conditions of the country, and change whenever necessary. He should visit each section frequently, and when any are behind have the delinquent party reenforced until it can keep up. For example: If the barmen are slow, and the linemen wait for them, one of the linemen, or a man from the reel, should be detailed at once to help out the delinquents. The officer should also see that the linemen are supplied with insulators and wire before the supply is exhausted. This may be done by having some dropped off the line wagon with the poles at convenient intervals. The officer should reconnoiter in advance and advise the sergeant of the best route to take when the course has not been previously examined and laid out.

When the number of signal men is insufficient, other detail soldiers may, with a little instruction, be used for clearing branches from the wire, as the extra man at the reel or as additional barmen.

In a camp where there is much lance construction, a mounted inspector should patrol the lines at least once a day. He should respond immediately when notified by the central exchange of trouble on any line. His equipment should be a lineman's outfit, and a short crowbar which can be carried in a carbine boot.

It is very often the case that the four-mule army escort wagon is used as a lance truck as well as for carrying the reel, and it will be found convenient in operating the reel to place it across the wagon box. This gives plenty of room for the reelmen to work, and affords a place in the bottom of the wagon for carrying about 100 lances. A hand reel fastened across the wagon box has the advantage of being easily taken off to "buck" through places impassable for a wagon. However, this can not be done with many styles of signal-corps wagons.

Sandy soil presents many difficulties to telephone-line construction, not alone from the instability of the lances, but the difficulty of making good ground returns. It requires a metallic circuit, where the soil is sandy, to give good service. The return wire should parallel the main-line wire, and where a common return is used for several lines such lines should parallel the return wire as far as practicable to prevent induction and "cross talk."

No. 14 galvanized-iron wire is the most suitable for lance line construction. The same size of copper may be used, but it will not stand the hard service and twists like the iron wire. Wire as large as No. 9 may be used, but is too large to pass freely through "pig tail" insulators, and in pulling taut the poles bend out of shape and the hard-rubber insulators frequently break.

The methods of attaching telephone and telegraph instruments and inside wiring at central stations is not pertinent here. Lightning-arresters should never be omitted, as lightning might unexpectedly disable a system beyond repair with the materials at hand.

SELECTION OF SITES FOR SEARCHLIGHTS.

The question of selection of sites for searchlights to be used in connection with coast defenses can be treated only in a general sense, as the subject is one which depends entirely on the nature of the surrounding terrain, and each individual case must be treated with reference to general rules, which may be tabulated. In considering this question, regard must be had to the purposes for which the searchlights are intended, and these may be stated generally to be, not only the covering of the mine beds in the immediate vicinity of the defenses but also the ascertaining of the whereabouts of a blockading fleet or an attacking force. The great object to be obtained is to ascertain the whereabouts of the enemy and at the same time prevent the enemy from locating the position of the lights. Naturally, high ground, which affords a large sweep, not only of the waters but of the adjoining land, is to be preferred. The stations are to be remote from the batteries and still close enough to be in communication with them in order to keep the gun captains informed of the whereabouts of the fleet. The searchlight stations should be so placed that even when seen by the enemy they will afford no information as to the whereabouts of the batteries, so that no range on them can be secured. If a spot can be selected which will fill the foregoing requirements and at the same time offer a natural defense for the light, it is to be preferred to one which must be artificially defended. The question of the defense of a searchlight station is one which must be settled like the one in regard to the site—each case will depend upon the surrounding conditions, but as a general rule it may be stated that the defensive position should be such as will insure safety not only to the personnel but also to the material, and yet not in any way conflict with the use of the light.

Stations should be selected so as to keep within range of one another, so far as the beams of the lights are concerned, and in order that the entire mine field may be covered, as well as all approaches to the defense.

A firm, hard foundation should be constructed for the light proper, and the wires leading to the light should be placed in conduits embedded in the earth to a sufficient depth to be protected from gun fire. The motor and dynamos should be in bombproof structures and sufficiently removed from the lights and from the guns as to place them in a position of security.

In connection with the general subject of searchlight stations, it may be stated that the same general requirements should be fulfilled as in the selection of stations for range finders.

The use of the searchlight in connection with permanent defenses of the coast is not of material importance, so far as the Navy is concerned, so long as these defenses and the adjoining mines are under the control of the Army. The only purpose of recording the general requirements of such stations is to have the necessary data at hand in case a landing party of the Navy, in connection with the ships of the fleet, successfully attacks some defense of the enemy and takes charge thereof and desires to make at least semipermanent occupation.

The subject of the use of the searchlight in connection with semipermanent defenses is restricted to what may be termed portable searchlights, which can be taken into the field and used there. The Signal Corps of the Army has successfully used such a portable searchlight in the campaign in the Philippines.

The searchlights used for this purpose are manufactured by the General Electric Company, and in all particulars of manufacture follow closely the lines of those used on board ships, but of course are of smaller dimensions. As a general proposition the portable searchlight should be constructed so as to insure efficiency of action, economy of power, and readiness of transportation. The searchlight used in the Army fulfills these requirements, and has been used not only for searching battlefields for dead and wounded, but also as a screen, and for reconnoitering purposes on armed trains and columns in the field.

The Army light requires two carriages—one for the motor which produces the current, and the other for the light proper. The wagons are constructed so as to be readily transported over roads of almost any character.

SEARCHLIGHTS FOR COAST DEFENSES.

In connection with the subject of searchlights for coast defenses, a letter, addressed by the Chief of Engineers of the Army to the Secretary of War, is of importance as indicating not only the use to which the searchlight can be put in connection with the coast defenses, but also a general scheme which will serve as a very good specimen, and can be varied in accordance with the terrain:

OFFICE OF THE CHIEF OF ENGINEERS, U. S. ARMY,

Washington, November 30, 1900.

SIR: I have the honor to report that the recent combined land and naval maneuvers at Newport have brought out most forcibly the great utility of searchlights in connection with the land defenses of our seacoasts. The effect produced by these lights were reported to be threefold: (1) They enabled the defense to detect the approach of naval vessels at night, not a single torpedo boat having succeeded in passing the batteries without such detection; (2) they enable the gunners to follow a

moving target continuously, so illuminating the vessels as to clearly define the water line, on which the determination of range depends; (3) they "killed out" the searchlights on the vessels and dazzled their pilots so completely that they had to slow down, and one boat had to anchor.

At the maneuvers there were present the Board of Engineers, three other engineer officers—one at each battery manned by artillery—and a number of distinguished artillery officers. They are unanimous in expressing the belief that the utility of the searchlight had not before been sufficiently appreciated, and in the following recommendations:

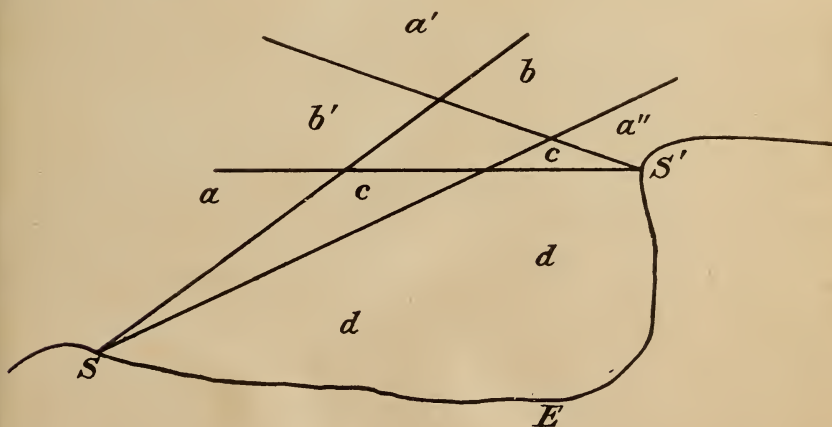
(1) That each individual battery should have its own searchlight, so that its guns could follow up a ship continuously.

(2) That there should be one or more searchlights under the control of the commanding officer of the entire defense, which should be used exclusively to detect new vessels coming into view. For this purpose some officers suggested that fixed lights were the best, their rays being so pointed as to cover the main and other entrance channels, one light being needed for each separate entrance.

(3) That several very powerful searchlights should be also under the control of the commanding officer, who could concentrate their glare on the leading or other vessel at will.

SEARCHLIGHTS.

Lights with a fixed direction of beam are advocated by many, and may be used to advantage under some conditions; but they possess the disadvantages of a necessarily low site, their location and range is readily obtained by an enemy, and an inspection of the diagram below would convince one that a patient and vigilant enemy would have little trouble in passing the lines of rays without being discovered until too late.



S and S' are two fixed lights at the entrance to the harbor: E the position of the battery. It is evident that any object in the spaces *a*, *a'*, and *a''* are invisible from E; also invisible in the areas *b b'* if both lights are turned on. The object will be visible by direct light in the areas *c* and *c'*, and will be silhouetted in the area *d*.

Suppose an attack is to be made by six torpedo boats. If both lights are in operation they can move anywhere in the area a, a', a'' without detection; but as a matter of precaution they concentrate at a' , where they will be invisible whether one or both lights are in operation. They will wait here until one of the lights needs readjusting, when the nearest division will slip into the area a'' , or a' , according to whether it is S or S' that goes out; from here they are in a position to dart through the protected zone when the light nearest them requires readjusting, and are safe from any direct rays.

Almost all of the above statements are based on theory. It has been impossible to find any record of a systematic and exhaustive series of experiments to determine the best height, location, or method of using shore searchlights for defense against sea attack, and these points can only be definitely settled by such practical experiments.

For obvious reasons all the recommendations contained in the letter, *supra*, from the Chief of Engineers, U. S. A., can not be carried out in semipermanent defenses, but we should so place the lights at our disposition that they may work to the best advantage for the largest number of adjacent batteries, and should use the most powerful lights that conditions will permit of. A feeble light is worse than none; it indicates more or less generally the location of the defenses, and the gunners can do better without any light at all than with one that lights up objects dimly.



RANGE FINDERS.

[Extract from Notes on Naval Progress, July, 1900, pp. 161-168.]

THE BARR AND STROUD RANGE FINDER.

This instrument has been adopted by the British Admiralty, and is also used in the navies of Austria, Japan, and other foreign powers. One has just been placed on board the *Albany* for trial.

A full description of the special features claimed for it, its principle, construction, and the various uses to which it can be applied are therefore given.

SPECIAL FEATURES OF THE BARR & STROUD RANGE FINDER.

1. It occupies very little space.
2. It requires only one observer, and thus avoids the necessity for communication between men at different stations and the consequent danger of errors.
3. The ranges of any objects visible from the range finder can be taken quite irrespective of their bearing or altitude.
4. The operation of the instrument is so exceedingly simple that no difficulty is found in using it successfully after a few minutes' trial.
5. Its standard of accuracy is very high; higher, it is believed, than that of any other range finder.
6. The indications depend solely upon the base length, the angle of a deflecting prism, the focal length of the objectives, and the graduations of the scale. There are, therefore, no parts the wearing of which can cause the instrument to give erroneous readings.
7. It is particularly free from liability to derangement.
8. If deranged it can readily be readjusted.
9. It is capable of standing all ordinary usage without derangement, and is in no way affected by the shock of gun fire.
10. The arrangements for "finding" the object, aligning the images, and reading the scale are such that it is found possible to accurately determine the range of an object in from eight to twelve seconds from the time the observer reaches the instrument.
11. The arrangement for reading the scale enables a moving object to be kept constantly in view and its range taken as frequently as desired.
12. When observations have to be made in rapid succession, the eyes need not be taken from the instrument. This avoids exposure of the

THE BARR AND STROUD RANGE FINDER

PLATE I.

DETAILS

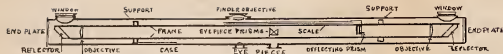


Fig. 1.

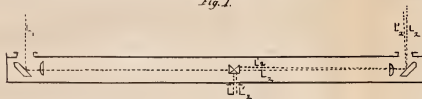


Fig. 2.

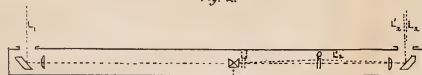


Fig. 3.

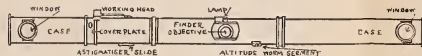


Fig. 4.



Fig. 5.



Fig. 7.



Fig. 8.



Fig. 9.



Fig. 10.



Fig. 11.



Fig. 12.

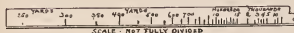


Fig. 13.



Fig. 6.

eyes to strong light, which would render them for some time incapable of making delicate telescopic observations.

13. The distance of a light can be taken at night as easily as the distance of a ship or other object can be determined during the day.

14. The instrument can be rapidly dismantled and again erected, or changed from one position to another without any of its adjustments being affected.

15. The instrument is always ready for use; there are no preliminary adjustments necessary.

16. As mounted on board ship it is the most convenient and accurate instrument yet invented for navigational distance finding, both by day and by night.

17. For use as a fortress range finder it may be placed close to the sea level or at any convenient altitude, and requires no adjustment for height above sea level or for changes of tides.

PRINCIPLE OF THE INSTRUMENT.

(See Pl. I.)

Figure I is a diagrammatic representation of the instrument, details of construction being omitted for the sake of clearness in the explanation of the principle of operation.

Two beams of light from the object viewed are received by the reflectors and transmitted through the objectives toward the center of the frame, where an arrangement of prisms is placed to reflect the beams outward through the right-eye piece. By these means two partial images of a distant object are seen, one over the other, as shown in figure 9; the image seen in the upper half of the field of view of the right-eye piece being formed by the equivalent of a telescope directed toward the object from the right-hand end of the instrument, the image seen in the lower half being formed by the equivalent of a second telescope directed toward the object from the left-hand end.

The images are seen separated by a thin black line, as shown in figs. 8 and 9. This line is called the "separating line."

Suppose a very distant object is viewed by rays shown at L_1 , L_2 (fig. 2), and that the partial images of that object are seen in correct coincidence, as illustrated in figure 8. If, now, the object approaches the instrument along the line L , the beam of light received by the right-hand reflector will take a different direction, such as is shown by the line L_2 , and the partial images will no longer appear in proper coincidence, but will occupy such relative positions as are shown in figure 9. (The relative position of the images is not affected by any turning of the instrument in azimuth; the images move together across the field.) The partial images might be brought together by rotating one of the reflectors, but the necessary rotation would be almost infinitesimal, and

would consequently require to be made and indicated with excessive delicacy.

The bringing of the two partial images into coincidence is effected in this range finder by means of a "deflecting prism" of small angle (fig. 1), which is placed in the path of the rays from the right-hand reflector and is movable longitudinally in the tube. The action of this prism in producing coincidence is illustrated in fig. 8. The partial images of a very distant object are in coincidence when the deflecting prism is in position N, but the prism has to be moved to the position O in order to bring the partial images of a near object into coincidence.

As usually constructed, a motion of the prism of about 6 inches (150 millimeters) corresponds to a change of range from infinity to 250 yards (or meters).

An ivory scale (fig. 1) is attached to the refracting prism carrier, and on it the distance of the object viewed is read by aid of a scale lens in the left eyepiece, the scale being graduated to give the distance directly in yards or meters, or any other unit.

It should be particularly noted that since the scale is attached to and moves with the deflecting prism, slackness or irregularity in the gear by which the scale is moved produces no error in the indications, and therefore no amount of wear can affect the accuracy of the instrument.

CONSTRUCTION OF THE INSTRUMENT.

(See Plate I.)

Externally the range finder consists of a double tubular case, about 5 feet (1.5 meters) in length and $3\frac{1}{2}$ inches (9 centimeters) in diameter, shown in figs. 1, 4, and 5.

A frame (fig. 1) carries all the optical parts of the instrument, with the exception of the eyepieces, finder objective, and windows.

This frame is carried within the tubular case on two supports, which are so arranged that no deformation of the framework can result from the application of forces to the case.

Each range finder is thoroughly tested for temperature effects and is compensated, if necessary, to provide against errors due to this cause. Differential heating of the frame would cause it to bend, and the readings of the instrument would thereby be affected. Errors are entirely prevented by the peculiar form of the frame and by constructing the outer case of two tubes, one inside the other. This greatly retards the transmission of heat to and from the interior, and distributes it evenly around the frame.

The deflecting prism and the scale attached to it are moved by means of a screw. This screw is actuated by a working head (fig. 4), which is placed on the upper side of the tube in a convenient position for being operated by the observer's right hand.

The nature of the scale is shown in fig. 13, but the graduations are too numerous and come too close together to admit of the scale, as actually cut on the ivory, being represented on the drawing.

The scale is usually divided in single yards from 250 yards to 500 yards, in tens of yards to 1,500 yards, in hundreds of yards to 5,000 yards, and in thousands of yards to 10,000 yards; marks are also cut for 15,000 yards, 20,000 yards, and infinity. (Similar graduations are made in the case of meter scales.) Special modes of graduation can be adopted when required.

The centers of the eyepieces are placed at $2\frac{1}{2}$ inches (64 millimeters) apart, but the left eyepiece (fig. 5) is arranged to make the instrument equally convenient for observers whose eyes are at a greater or less distance than $2\frac{1}{2}$ inches apart.

The scale is read by the left eye when the images seen by the right eye have been brought into alignment. After a little practice, the two eyes can be used alternately or simultaneously for their respective duties without losing the object from the field of view of the right eye while the scale is being read.

A very simple and efficient "finder" is provided to enable the observer to immediately direct the instrument upon the object. This finder consists of a small telescope of low magnifying power, the objective of which is seen in figs. 1 and 4, and which is used by the left eye, the scale occupying only a portion of the left-eye field, as shown in fig. 7. The field of view of this telescope is wide enough to enable the observer to at once "find" the object whose distance is required, and when the instrument is so directed as to bring the object into the center of the finder field (see fig. 7) the object will be found, greatly magnified, in the field of view of the right eyepiece (fig. 8.)

An india-rubber face piece (figs. 5 and 6) is fixed to the tube around the eyepieces. This, by giving a soft rest for the brow, makes the instrument more comfortable to use, especially when guns are being fired in its vicinity. It excludes light other than that received through the eyepieces and it guides the eye to the eyepieces in night observations when, from the small amount of light received, the eyes otherwise would not immediately find the apertures.

For taking the distances of lights at night, such as ships' lights or light-houses, an optical appliance, called the "astigmatiser," is provided in the interior of the instrument. The astigmatiser draws out each image of a point of light into a vertical streak (fig. 10), which can then be aligned exactly as the images of a mast or other object are aligned in daylight observations. The astigmatiser is put into or out of action by means of a slider (fig. 4) actuated by the thumb of the right hand.

In order to render the scale visible at night, a small electric lamp—identical with those used for the night sights of guns—is fitted on the instrument, as shown in fig. 4. A small battery may be used to

supply the current, or, if preferred, the lamp wires can be arranged to lead current from a "transformer" circuit. A contact maker (fig. 5), actuated by the right hand, switches on the lamp when the scale is to be read at night.

It is found that the instrument, unless it meets with an accident, seldom, if ever, requires adjustment. Two adjustments are, however, provided for, called, respectively, the adjustments for "halving" and "coincidence."

The former is to accomplish the condition that the two partial images shall form a complete one and neither show "duplication," as illustrated in fig. 11, nor "deficiency," as illustrated in fig. 12.

The adjustment for coincidence is to accomplish the condition that the scale shall give the true distance of an object from the range finder when the partial images of that object are seen in correct coincidence or alignment, as in fig. 8.

This adjustment thus corresponds to the index adjustment of a sextant, but is not convenient to work in a range finder with an "index error," owing to the scale not being a uniformly divided one.

These adjustments are accomplished by means of two milled heads, rendered accessible by partially rotating the cover plate as shown in fig. 4.

The "halving" adjustment can be tested by observation on any object at a distance of over 250 yards. The distance of the object does not require to be known.

The "coincidence" adjustment is conveniently tested by observation upon the moon or a star, when the reading of the instrument should be "infinity"—indicated by the star-shaped mark on the scale.

Windows of optical glass are fitted over the apertures (see figs. 1 and 4) and the outer case is everywhere so closed as to prevent rain, spray, or dust gaining access to the internal parts of the instrument.

Sunshades are provided to fit over the windows, as shown in fig. 6, to afford some protection against the rain or spray settling upon the windows and to exclude direct sunlight.

The details of the instrument are made as far as possible on the interchangeable system, so that if any parts are lost or mislaid they can be readily replaced.

ACCESSORIES.

The range finder is supplied in a strong teak-wood box, and it is held in the box by rubber pads and leather straps to prevent the instrument receiving damage while out of use, and especially during carriage.

Spare electric lamps, cloths for cleaning the windows, and other accessories are provided.

A waterproof cover is provided, which can be thrown over the

instrument when it is desired to leave it in position, but not in use, for some time; but the instrument is designed so as to be capable of standing exposure in all ordinary weather.

Detailed instructions for using the range finder and its mountings are supplied with each instrument.

ACCURACY.

The range finder above described is of 4 feet 6 inches (1.37 meters) base, and is recommended for use in connection with guns on war ships of all kinds, forts, shore batteries, etc.; also for submarine mining operations, and for navigation.

The table of test readings given at the end of the description will serve to indicate the accuracy obtainable under good atmospheric and other conditions.

These readings were taken in the ordinary course of testing and adjusting instruments before delivery.

If for any special service greater accuracy is desired at very long ranges than can be obtained with a base of 4 feet 6 inches, instruments with longer base can be made to order; and for use on torpedo boats or other small craft a range finder of 3 feet base can be supplied.

The 3-foot-base range finder is also supplied for use with field artillery, and for that purpose is made largely of aluminum and weighs only 15 pounds (about 7 kilograms).

TRANSMITTING AND RECEIVING INSTRUMENTS.

Instruments for transmitting ranges from the range finder to the conning tower, and for transmitting ranges and orders from the conning tower to the gun stations have also been supplied to vessels.

USE IN MANEUVERS, NAVIGATION, ETC.

An instrument that can measure the distance of any object in a few seconds, by night as well as by day, must commend itself to officers engaged in maneuvering. No data respecting individual ships are required, as is the case with "station keepers" or sextants when used for range finding, and the observer is able to tell almost at a glance the distance of any vessel in the fleet.

The range finder will also be found useful in carrying out tests of the maneuvering qualities of individual ships without interfering with the customary exercises and tactics. For example, the turning circle of a ship under any given circumstances can be worked out by causing the ship to steam around or near a floating object—such as another ship or a small boat or target carrying an upright pole—determining the distance and bearing of the object simultaneously at given intervals of time and plotting the data thus obtained.

Again the speed of a vessel can be determined by causing it to steam past a stationary vessel or small boat and noting the instant when the object is, say, 1,000 yards ahead, and again when it is 1,000 yards astern. The speed of a vessel can be ascertained in this way with quite sufficient accuracy for all ordinary purposes, and, indeed, well within the variations of speed that result, under nominally identical circumstances, from unknown causes, say within 1 per cent. And as this does not necessitate the taking of the vessel to a measured mile it can be carried out as frequently and under as great a variety of circumstances as may be desired. It will be evident also that as the vessel and the floating object partake alike of the motion due to any general current the effect of such current is eliminated.

THE WELDON RANGE FINDER.

There are several forms of this instrument, but the methods of using the prisms, or of finding the range with them, is the same for all.

In the following instructions the watch-shaped instrument is the one described, and it requires more manipulation than the compass range finder. Those parts of the instructions that refer solely to the watch-shaped instrument are *in italics*. The other portions will be understood as referring to both instruments.

The two instruments described here are the original service-pattern watch-shaped range finder, and the compass or surveying range finder.

The latter instrument has the three prisms fixed one above the other. By this arrangement, when the instrument is opened out, and the protecting cover used as a handle, the three prisms can be brought into position before the eye of the observer, and any of them used without having to take the eye off the object observed, as would be necessary in the original pattern. Also without removing the range finder from the eye, objects to the left of the observer can be viewed by simply turning the instrument so that the apex of each prism shall point to the object to be reflected.

The metal cover which forms the handle has four notches cut in it. These serve to support a pencil in such position that when the needle points due north the pencil will point E. and W., N. E. and S. W. and S. E., as it is laid either transversely or diagonally in the notches.

The level fixed below the third prism is used to place the instrument in a position to observe the transit of the sun over the meridian, as explained further on, and it assists the observer to keep the instrument upright when range-finding.

I. CONSTRUCTION OF THE INSTRUMENT.

The instrument consists of three prisms securely fixed in metal frames. Each prism reflects a different angle. These angles are 90° , $88^\circ 51' 15''$, and $74^\circ 53' 15''$.^a

For convenience of reference the three prisms are called respectively first, second, and third. The first is 90° ; the second is $88^\circ 51' 15''$;

^aThe first and second angles, viz, 90° and $88^\circ 51' 15''$, are the angles at the base of a right-angled triangle, of which the base is to the perpendicular as 1:50. The complement of the second, viz, $91^\circ 8' 45''$, and the third are the angles of an obtuse-angled triangle, of which the base is to the side subtending the angle $74^\circ 53'$ as 1:4.

the third is $74^{\circ} 53' 15''$ (in the handle), and this is the order in which they will most frequently be used.

The following names are given to the different parts of the watch-shaped instrument: The case ring; the prism block; the handle.

II. HOW TO USE THE PRISMS.

In using the watch instrument the prism block is turned at right angles to the case ring, and there are two positions in which it can be held:

First. With the apex of the prism toward the eye of the observer. The reflection of an object to the right (or left) of the observer is to be sought for in that corner of the prism which is farthest from the object.

Second. It can be held with apex of the prism toward the object. The reflection is, in this case, to be sought in the corner nearest that point.

With the third prism in watch instrument the reflection of the object is looked for in the corner of the prism nearest to the case ring and farthest from the object.

OBSERVATIONS.

In the first or right-angled prism the three corners are available for observation, and therefore the whole surface is open.

In a prism reflecting an angle not a right angle one corner is not available for observation; in the second and third prisms these corners are covered or cut off.

When holding the instrument by the case ring, so as to steady the prism block with the thumb and forefinger, an open space should be left below that corner of the prism which is being looked into, in order that objects seen by direct vision, below as well as above the prism, may be viewed simultaneously with the objects reflected in the prism.

It will be necessary to look below the prism, when the upper disk of the prism block appears to interfere with an exact coincidence, or when there is a glare from it.^a

Objects to the right (or left) reflected in the prism, that appear directly underneath (or above) those seen in front by direct vision, form with the eye of the observer the angle to which the prism is cut.

A little practice is at first required to readily discern in the prism any object indicated to the right or left, but by holding the instrument close to the eye a large field is obtained, and a very slight movement of the head to the right or left is all that is required to bring a fresh field into view.

^aThe glare can also be got rid of by shading the instrument with the unoccupied hand.

When the reflected image of the object indicated has been obtained, it can be made to move up or down by slightly tilting the instrument, so as to make the reflection coincide with any point selected in front of the observer.

To make a correct angle the reflected object should be kept upright and the reflected horizon as level as it is naturally, for if the instrument is held so that the ground reflected appears to slope when it is really level, or made to appear level when it slopes, the required angle will not be made.

An object reflected in the prism can be aligned with any given point in front seen by direct vision, by the observer moving to his right or left, backward or forward.

Thus, if an object, O, reflected from the right appears to the observer's left of an object, D, in front of him, O can be brought immediately under D by moving straight forward if D is distant, or to the right or diagonally to the right front, if D is nearer.

If O appears to the observer's right of an object, say O is in front, he must step back, or move to the left until alignment has been effected.

If the object O has been reflected from the left, movement exactly the reverse of the above should be necessary in obtaining alignment.

It will be understood that the right eye is used for observation, and therefore the reflected object appears always on the right.

RAFFERTY DEPRESSION POSITION FINDER FOR HEIGHTS FROM 30 TO 60 FEET.

This instrument is designed to obtain the range and azimuth of an object from the observing station.

It consists of a lower and upper limb. The function of the lower limb is to level the instrument and to carry the azimuth ring, which is graduated to degrees, the degree spaces being alternately black and white; a pinion with milled head rotates the azimuth ring when adjusting the instrument in azimuth. Three leveling screws having feet shaped so as to fit in V-shaped grooves on the foundation, and so that they must be clamped to the foundation by slotted levers; the instrument is thus rigidly attached to its foundation without interfering with the use of the leveling screws. The rest of the angle-measuring part of the instrument consists of a worm on the under surface of the upper limb, which works in a worm gear cut on the cylinder of the lower limb; the worm is rotated by a wheel which is pivoted on the upper limb, and which is graduated into two degrees of sixty minutes each, one degree of sixty minutes being marked black and one degree

white; the black degree of this wheel, which causes two-degree horizontal circular motion in one of its revolutions, corresponds to a black degree on the azimuth ring, and the white degree on this wheel corresponds to a white degree on the azimuth ring. In using both the degrees and the minutes the *space* is considered and the *space* is numbered; the reading is the number of degrees or minutes which is opposite the index. For use in adjustment two clamp screws attach the graduated part of the rotary wheel in its gear. A spring pressing against the worm frame secures uniform contact of the worm in its gear; when leveling and transporting, the worm is withdrawn from engagement by a handle under the disk and is clamped out of gear by a lever.

On the upper limb is mounted a frame having two side rails, and it carries the parts used in finding ranges and levels. Attached to the telescope, by two brackets, is the parallel circular bar; this bar supports a traveling carriage, the movement of which along the bar is effected by a handle. This carriage has two pivots which rest in shoes, and the latter rest on the side rails of the upper limb. The telescope is pivoted, therefore, on these pivots. On one side rail is a scale of heights; knowing the height above the surface of the water, the handle is operated to move the carriage until the index on the shoes is at the known height, according to the scale of heights.

A third bracket, fixed to the telescope near the eye end, rests on a nut which moves vertically, due to the turning of a screw and the guiding of the frame. The male screw having a range disk rigidly attached to it works in a female screw in the nut, and the motion of the range disk raises or lowers the nut, and through it, the eye end of the telescope.

The range index is a traveling carriage which is guided by a radial jointed arm; this arm is pivoted on a screw so that the arm may have a rotary adjustment about this screw, and also an adjustment radially to the range disk; this arm is clamped in any position by a clamp bar, which, actuated by thumb screws, presses the arm against the bracket. The bar has a graduation representing a scale of heights, which scale is used in conjunction with the scale of heights above referred to, and is a guide for the correct setting of the jointed arm at different heights.

To set the scale correctly straighten it and place it so that its reading is the height; then hold the inner branch with one hand and with the other bring the other branch to a position such that its reading edge crosses the arrow point in front of 45; then clamp with screw.

The range disk is geared, and rotary motion is given to it by a pinion operated by a handle.

OPERATION.

Set both height scales at approximately the correct height level.

Set range scale at the range of some datum point at short range, where refraction is small—say, from 2,000 to 3,000 yards. Sight on this point, and move the carriage until the horizontal hair is on the water line; the two height scales should then correspond.

Sight on a long-range datum point, and, if slightly out, move outer branch of jointed index arm to the correct range.

To adjust in azimuth, direct the telescope on a point the azimuth of which is known, set the degree scale first at about its correct position, then unclamp the minute wheel and set that correctly on the corresponding color, and clamp; turn the minute wheel to zero, and then turn the degree ring until the index is on the line between the two degrees.

SUBMARINE MINES.

It being accepted as an established fact that armored ships will have little difficulty in running past forts unsupported by any means of defense other than guns, the question naturally arises, What is the best form of defense to prevent this passage of the main factor of our defense? In the absence of our own fleet, all things considered, there can be but little doubt that the answer must be—obstructions.

Obstructions may be of various forms, such as booms, cables, rafts, piles, sunken vessels, or submarine mines; but it is intended to consider the latter, only, as being the most efficient and easily placed and removed, and allowing the free entrance and exit of our own vessels.

The office of submarine mines is twofold—the prevention of the passage of an enemy's vessel and the keeping him beyond accurate range of his object. The latter reason would, then, seem to give us the proper distance at which to place the mine fields. Very broadly speaking, this is true, but it is limited by a number of considerations, the most vital of which is that the obstructions must be within range of our shore guns, otherwise the enemy will have little difficulty in removing them. As this work would be performed by small, light-draft vessels, or small boats, upon which it will be necessary to bring a constant stream of projectiles, the distance is still further limited by the effective range of our small rapid-fire guns, or within 3,000 yards. The removal of obstructions would most likely be attempted at night only, so that the limit of distance for our mine field is limited further by the effective range of the searchlight, or to about 2,000 yards.

This, then, is the distance which our mine field should be placed in advance of our outer line of batteries. The passage of the forts would be prevented by placing them anywhere in the channel, the closer in the better, but that would defeat the second object, and allow the enemy to close in to very accurate range and silence the batteries with a storm of small projectiles.

Before going further it may be well to mention briefly the various classes of mines. These may be divided into two main classes: 1, controlled mines; 2, uncontrolled or contact mines.

The first class is again subdivided into: 1, ground mines; 2, buoyant mines. These are again divided into: 1, observation mines; 2, controlled contact mines.

While there are many forms of the second class, all have one property in common—they must come in more or less violent contact with some object in order to be exploded.

For the purposes of this paper only two types will be considered—the naval-defense mine and the countermine. Both are familiar to our naval officers, and, for obvious reasons, it is not deemed expedient to give a description of them.

The countermine can only be used for its legitimate purpose or converted into an observation ground mine. The defense mine can readily and quickly be converted into: 1, an observation ground mine; 2, an observation buoyant mine; 3, a controlled contact mine.

All of these types of mines have their several uses, though personally the compiler is in favor of the use of only two types—the simple contact for unused and shallow channels, and the controlled contact for refuge or ship channels. The use of the ground mine is limited by the depth of water, and all observation mines are open to the objections that an enemy may slip in during a fog; or, should the searchlights meet with an accident, the radius of action of a mine is extremely limited, and a ship must be almost directly over the mine to receive serious injury, and the explosion of the mine at exactly the right moment is problematical, owing to possible errors in bearings or faulty methods of communication between the stations.

The controlled contact mine explodes automatically only when in direct contact with a vessel. A smaller charge can thus be used, allowing the mines to be placed closer together; all errors of observation and communication are done away with; fog or darkness makes no difference, and, like the observation mine, it can be made safe for the passage of our own ships. The only serious objection that can be urged against its use is that the mooring line is liable to be entangled in the propellers of vessels. It would seem that this danger might be readily done away with by the placing of disappearing buoys, or even boats, to mark the position of the mine fields when it is necessary to use the channel. A vessel could then stop its engines before reaching the outer mark, if it is not thought that mere contact with the vessel's hull will injure the mine in the least.

While there are various methods of locating and firing observation mines that have been successfully tested in peace times, I do not know of a single well-authenticated case of a vessel having been injured by an observation mine. Aside from this, it is believed that the system is too complicated and too much material will be required to make their use advisable for semipermanent defenses.

Ground mines, as the name implies, are intended to be placed upon the bottom, and are primarily observation mines, but may be made contact, or even controlled contact, by the addition of a buoyant case

electrically connected with the mine, carrying the contact closer. The countermine is readily converted into a ground mine.

The submarine mines which are used for the defense of harbors and channels fall within the province of the Army, but as they may also be used by an expeditionary force as a means of defense against an attack by a naval force, a general description of the various kinds of mines may be pertinent.

Submarine mines, generally, consist of cast-iron or steel cases in which is contained a large amount of explosive which is detonated either mechanically or electrically. The cases for ground mines may be of cast-iron of a hemispherical or similar shape, while those of buoyant mines are of mild steel of spherical shape. They have a volume which gives them sufficient buoyancy to sustain their own weight, that of the charge and mooring cable, and enough excess to prevent them from being too much depressed in depth by the action of the currents where they are to be used.

The explosive now used in mines is either gun cotton, dynamite, or explosive gelatine.

Buoyant mines are used in deep water and have an anchor attached for holding the mine in a position floating just below the surface; the mine contains the charge, the fuse, and the "circuit closer." The "circuit closer," instead of being in the mine, may be placed in a separate buoy and so floated that when touched by a passing vessel the mine will be brought directly under the vessel and detonated. A number of these buoyant mines can be easily placed in a channel and so arranged with respect to each other that no vessel can pass without coming in contact with one of them. The system should be arranged with easy electrical tests, so as to be able to know at all times whether or not the mines are in working order. The mines are either self-igniting or controlled from the shore. The self-acting, once placed, close the channel to both friend and foe. Those controlled from the shore by electricity may at will be made active against hostile or harmless toward friendly vessels. The latter only can be employed in harbors which are to be used for naval or commercial purposes.

As stated above, the buoyant self-acting mine is exploded by contact of a vessel with the mine itself; the ground mines by contact with the buoy, the explosion being caused by the action of a very sensitive fuse.

In mines controlled from the shore, the buoyant mine itself and the buoy attached to the ground mine carry a "circuit closer," which, acting under the shock caused by the vessel striking them, either announces the contact to the operator in the electrical room or fires the mine, as may be desired. In some cases they are fired only by the action of the operator, the position of the vessel being determined by the observers on shore.

The details of the circuit closers, annunciators, and arrangements for firing the mines differ materially, so that no general description can be given.

Besides the electrical mines, mechanical contact mines are also used. They consist of a water-tight mine case, of sufficient buoyancy to float when loaded with a charge of high explosive, and which is held at proper depth under the water by an anchor line leading to a mushroom anchor, a small buoy, held just beneath the surface by a line strong enough to lift the mine and anchor, enabling the mine to be located when it is desired to raise it or move it. Lever arms operating plungers which fire percussion caps or release explosive chemicals project from the head of the mine and are supposed to act when struck with sufficient force. Great care must be taken lest barnacles and other matter get in the plunger and thus render the mine useless. The mines in Guantanamo Bay which were struck by the Texas and Marblehead had been rendered useless by sea growth in the plunger.

COUNTERMINING.

If it be desired to open a channel in a mine field or to destroy the connection to submarine mines, it is done by countermining, which is effected by dropping mines in succession from a light-draft, swift steamer and exploding them simultaneously as soon as the run across the mine field is accomplished. This is a very hazardous undertaking, and is not always successful. If the mine field is undefended, the mines may be lifted by dragging the field by small steamers which have in tow a small chain.

See Ingersoll's Ordnance Gunnery for a drawing showing various group formations for fixed submarine mines.

DEFENSE OF MINE BEDS.

A mine field is swept by batteries of rapid-fire guns on shore to prevent the mines being disabled by the enemy, and it may be so contrived that upon the disturbance of any mine by a boat an automatic fire of grape, canister, or shrapnel may be concentrated upon it. Electric lights to sweep the lines of mines give additional security against the enemy clearing the obstructions.

A few rules for planting defensive torpedoes are given by Ingersoll, and they are tabulated herewith:

(1) A place should be selected and platted upon a chart, and the range established, the positions adopted being those where the water gives sufficient depth, and where the enemy's vessels are likely to pass, while, if possible, avoiding the strongest tide.

(2) The shape and size of the group of mines will depend upon the situation, the number of torpedoes to be employed, and the facility for landing the cables.

(3) Buoyant mines should be moored so that they will remain steady, and should be far enough apart that the explosion of one group will not affect any of the others.

Mahan, in his "Elements of Permanent Fortifications," lays down the following rules which tend to an efficient system of submarine mines:

First. The positions which they are to occupy should be selected, all parts of the permanent structures designated for their use prepared, and all the mines and their attachments provided, properly marked, and stored during peace.

Second. The mines should be as strong, cheap, and simple as is consistent with efficiency.

Third. They should, when used, be planted in multiple lines or groups so disposed as to close the channels, and their electrical connections should be so made that a limited number of cables being cut by enemy will not disable the mines in such a way as to open a channel through the lines.

Fourth. The lines and groups must be thoroughly swept by the fire of the large and small guns of the defense.

Fifth. Trained officers and men in sufficient number to place and work the mines must be always available.

TRANSPORTATION OF GUNS.

For landing the gun, a sailing launch may be used for a 4 or 5 inch gun, but two sailing launches will be required for a 6-inch. the gun supported on two heavy timbers resting across the gunwales.

At the selected landing place, the transporting ways should have already been placed, running as far out into the water as is practicable; on the offshore end of this the cradle should be placed, eyebolt or forward end of the cradle inshore. The boat should be brought with the breech of gun pointing inshore; to the outer end of the cradle the sheers are then erected over the boat, two heavy kedges being placed well offshore; to these are attached the outer sheer head guys, for easing the gun in on the cradle. The gun should be landed on the cradle, breech at eye end of cradle. Or, the launch may be brought broadside to the beach when the depth of water will permit, and the gun skidded ashore.

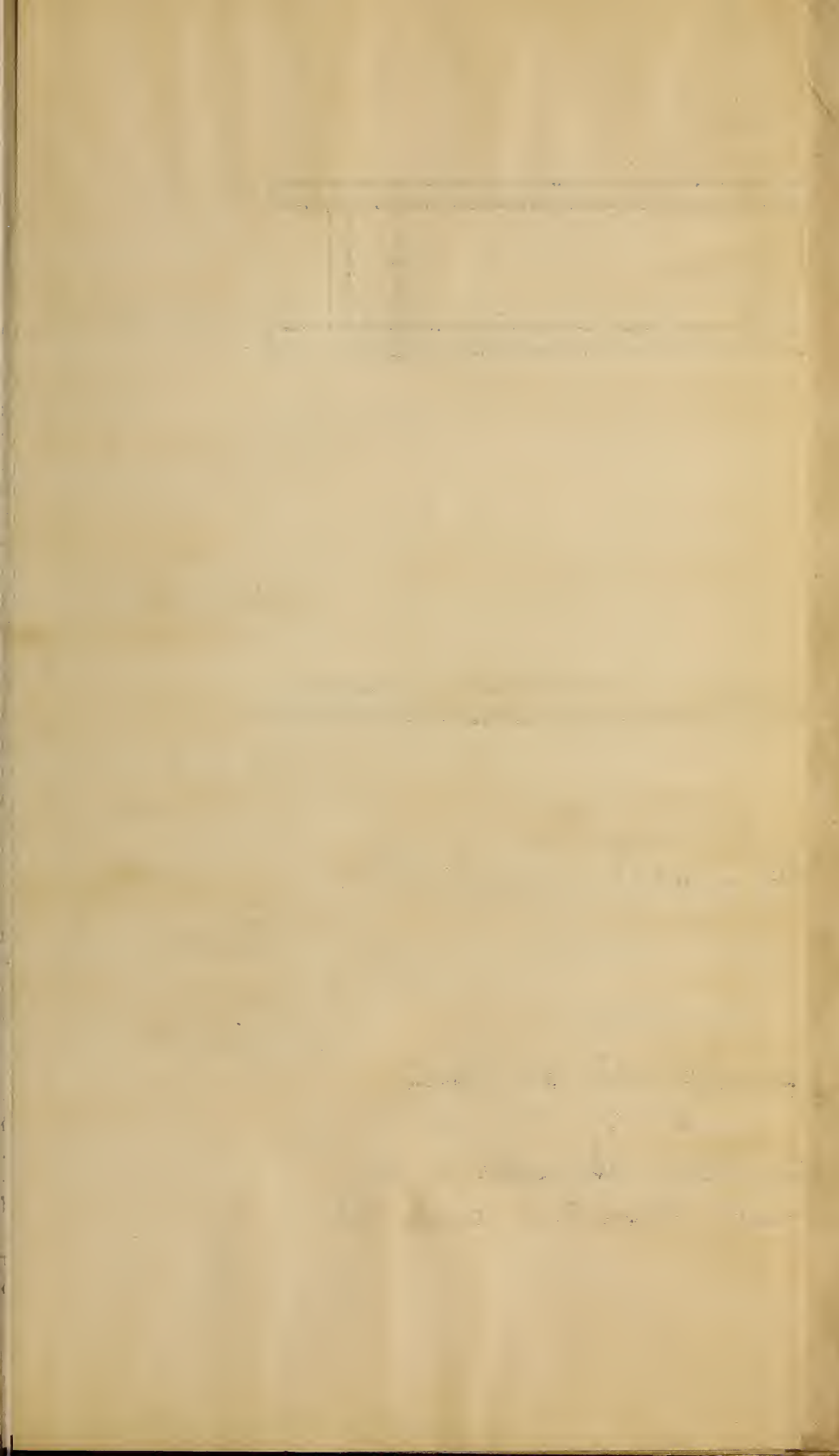
THE PLANT.

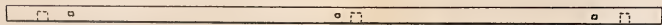
Ground ways.—These consist simply of two 6 by 8-inch clear pine timbers laid edgewise (8 by 10 inch would be safer for 6-inch guns) and held apart by three 4 by 5 inch spreaders evenly mortised into the ways. Three five-eighths inch iron tie-rods are used to prevent spreading. This construction admits of being easily and quickly dismantled, hauled to a position ahead of the gun, and as quickly assembled. If knots exist in the upper surface of the timbers, they should be cut down below the surface to insure even wear.

At least three sets of ways 30 feet long should be provided, with extra timber, tie-rods, and nuts.

If no rollers are used under the cradle, the upper surface of the ways should be kept well greased with beef tallow, tried out and applied warm. This seems to sink into the wood and holds well. Mutton tallow is not suitable. Linseed meal is then sprinkled on.

Cradle.—The gun cradle should be about 15 feet long. It is composed of two pieces of 6 by 8 inch pine united by three transoms, each end being held in place by two three-fourths inch bolts, as shown. The two forward transoms are placed together and backed by a half-inch iron washer about 8 inches square. Through these transoms and plate is passed a 1 $\frac{3}{4}$ -inch bolt with an eye in the forward end, as shown. (A similar bolt was found convenient in the after transom also, for holding back going downhill, though it is not absolutely necessary.)





Transporting Wags. (3 to a set)

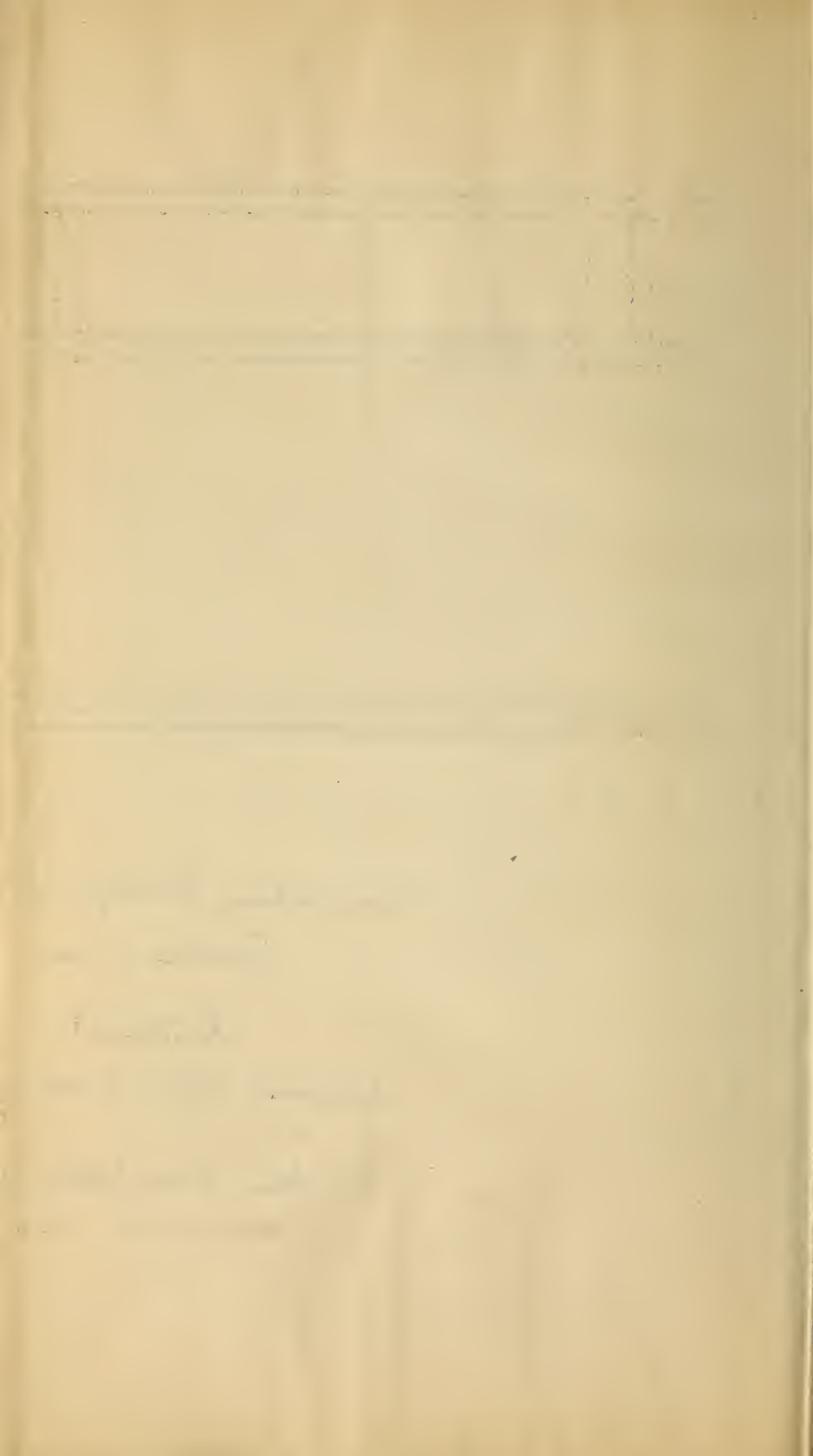
Scale 1" = 4'

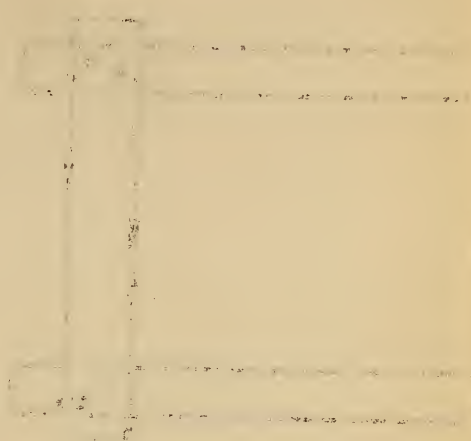
Material.

2 pieces, clear yellow pine 6" x 8", 32' long

1 " " " " 4" x 8", 15' "

3 - 3/4" iron bolts, 52" long, threaded 3" on
one end - one nut, 2 washers each bolt.

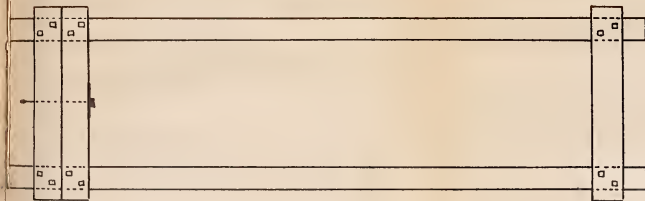




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2nd



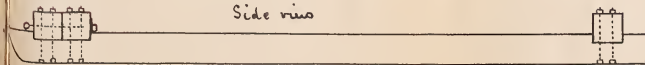


Material.

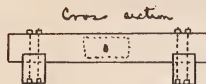
- 2 - pcs, yellow pine 6" x 8", 16' long.
- 1 " " " " 6" x 8", 15' "
- 12 - 3/4" rim bolts, 16" long, 1 nut, 1 washer
- 1 - 1 1/2" " " 20" " , eye one end
nut & plate washer other.

Cradle.

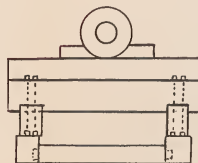
Scale 1" = 2'



Side view



Cross section



Way, cradle
view.



1884

Received of the
Library of the
University of
California
the sum of
\$100.00
for the purchase of
the book
"The History of
the State of California"

1884

1884

The top of the cradle is notched one-half inch to receive the ends of the transoms, and the latter are similarly notched. The ends of all transoms should project about 6 inches for convenience in holding, etc. On the under side of the cradle the boltheads should be countersunk.

The gun rests loosely on 8-inch beams placed loosely across the top of the cradle, the ends projecting about 2 feet to give facility in blocking up and the use of jacks. Of course more elaborate bolsters may be provided and secured by bolts, but this seems an unnecessary refinement. As it may be necessary to lift the gun, these beams should not be secured to the cradle, and if any doubt occurs some blocks or chocks may be bolted behind them.

Sheers.—Two spruce sheer poles (and one spare one) about 9 inches in diameter and 30 feet long should be provided, together with the necessary tackles, guys, and lashings.

TRANSPORTING.

Supposing the gun landed and on the ways. To haul up a grade of 1 6 or less, deadmen are placed along the line of haul at intervals governed by the length of tackle and ways. These consist of round pieces of wood (or iron piping) about 8 inches in diameter and 10 feet long. In readily worked soil they may be placed horizontally in pits about 5 feet deep, perpendicular to and in the line of travel. Chain, wire, or rope cables are placed around the deadmen and led out through a ditch cut at right angles to it. If the soil is hard, the deadman may be placed almost vertical and a little to one side of the line of travel. The wire, chain, or rope cable is passed around the deadman close to the ground. In the ends of this the forward block of the hauling tackle is hooked. (Grommets of $3\frac{1}{2}$ -inch rope were found to answer all purposes with the vertical deadman.) If short of men for the hauling tackle, portable crabs, or windlasses, may be used.

As the greatest strain comes in starting the gun, it should be assisted by jacks placed diagonally under the ends of the cross bolsters under the gun, which pieces were left projecting for that purpose.

The gun is then hauled forward until the tackle is block and block. If any doubts exist about slipping, dogs may be driven in the ways behind the cradle on stopping, but before casting off always place the jacks ready for the start, as described. On this grade little danger from slipping is to be apprehended, or at least is small, and the jacks afford ample security.

The way in rear is now dismounted and the pieces hauled forward and assembled in front. Light tackles will facilitate this.

On slopes over 1/6.—Here special precautions must be observed and great attention paid to the proper placing of the ways and to their foundations. A level placed at right angles to the line of travel and

on top of the ways should always indicate a horizontal. If the ground is soft and slippery, blocking under the ways should be resorted to.

The gun is always hauled breech first. A second tackle, the "preventer," is also attached, its after block hooked to the middle of a pendant, the eyes of which are placed over the trunnions. If the gun has no trunnions, a suitable strap may be run through the bore and toggled across the face of the muzzle. Little if any strain is taken on the "preventer" tackle, it being used for safety alone, though with a surplus of men it may be used to assist in the hauling. An additional precaution consists in the use of a heavy beam of suitable length, one end of which is wedged in the muzzle and the other left to draw behind on the ground at a suitable angle.

On stopping for any cause drive the dogs and place the jacks. Blocking should be used besides the jacks, placing it diagonally. Otherwise the operation proceeds as in the first case.

Turning points should be carefully selected beforehand and a deadman placed just beyond each turning point. By attention to this the number of deadmen may be reduced.

The route should be so selected that no very sharp turns will have to be made, otherwise a turntable will have to be constructed, or the sheer, brought into use, the gun lifted clear of the cradle, the latter hauled on to the ways in the new direction, and the gun placed on the cradle again.

IMPROVISED AUTOMOBILE TORPEDO BATTERY.

The annexed sketch shows a suggested form of an automobile torpedo battery. A number of types for such batteries have been advanced, but they are all of the platform type, either floating or on some form of wharf. As the present extreme range of the automobile torpedo is 3,000 yards, it is not believed that such types will survive the storm of rapid-fire projectiles which would be turned on them; it will hardly be possible to mask them perfectly except in very exceptional cases. It is not desirable to fire a torpedo from a platform where there is less than 12 feet of water under the mouth of the tube; thus in most cases the platform would have to be so far from shore as to preclude the possibility of any masking.

In the form proposed there is nothing in sight to attract attention but a small buoy attached to a rope or chain for hauling the cage to the surface, and this may be weighted so as to be a short distance below the surface, or dummy-buoys may be placed about.

The battery consists of four pipes, driven into the bottom at the proper distances apart and to the proper depth. It is important that the tops of these pipes should be at such a distance below mean low water that the top of the tube holding the torpedo shall be at least 3 feet below mean low water level. Into these pipes slide four smaller pipes, at the top of which is the cage holding the torpedo tube. The cage is made out of light T iron, bolted or riveted to the smaller pipe and to each other. A light sheet-iron cylinder is bolted or riveted in this cage. This tube is open at the front end, and partially closed at the rear end by two light iron straps. On top and near the rear end of the tube a slot should be cut to allow the tripping line to be attached to the starting lever. A line or chain, with a buoy attached, is fastened to the top cross pieces of the cage.

The normal position of the cage and tube is shown in the right-hand figure. When it is desired to use the battery, a couple of small boats are sent out—one to tow and place the torpedo, the other to raise and lower the cage. The cage and tube are brought to the surface by means of the rope, and the torpedo inserted until the propellers take against the rear straps, a tripping line long enough to reach the

High water line.

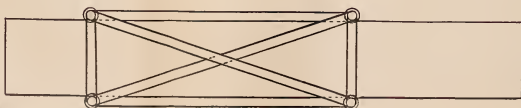
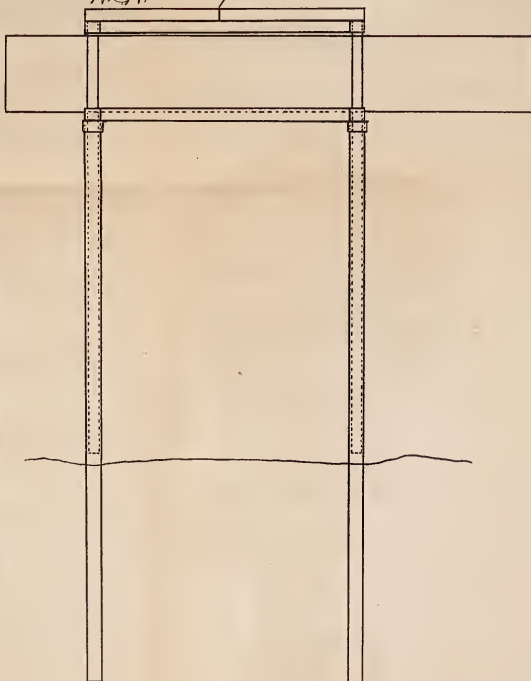
Low water line.

Automobile
Torpedo
Battery.

Scale 1" = 6".

1902

H.C.A.



selected position on shore is then placed over the starting lever of the torpedo, and the torpedo, etc., lowered into place. The battery is now ready for action.

By previous experiments the proper angle for the gear and a suitable range for the operator can be selected; the latter may consist of the stalks of two bushes. When the target crosses this range the operator, concealed on shore, pulls the tripping line.

The sketch shows—side view of battery—right figure, rear view of battery—left figure, and top view of cage and tube—lower figure.

SEA BASE OF OPERATIONS.

[Taken from "Lines of Communication in War," by Col. George Armand Furse, C. B., of the British Army.]

Nothing is of greater importance in the preparations for war than the establishment of a good base of operations, where depots may be formed for storing the vast accumulation of military stores, equipment, and provisions which are indispensable to feed a war.

This is the starting point of the lines of communication, where arrangements are made for forwarding all those reinforcements and materials without which it is impossible for an army or force to keep the field with efficiency.

With regard to its selection, this must in every case depend on circumstances. What is needed is a port which will satisfy three principal conditions, viz: It must be favorably situated with respect to the direction of the line of operations; it must offer a safe anchorage to a large number of ships; and it must possess facility for landing troops of all arms, and large quantities of war materials and provisions.

It is seldom possible to seize a good seaport otherwise than by stratagem, for all these are, generally speaking, protected by powerful batteries and held by garrisons of sufficient strength to undertake their defense. To make a sudden dash on any of the enemy's ports it is necessary to divert his attention from the locality where it is intended to effect the disembarkation.

Occasionally we may have already a suitable sea base in our hands or in that of an ally. Often, however, there is no other course to pursue but to land a body of troops on an open beach and undertake operations for the reduction of a suitable harbor.

The disembarkation of an expeditionary force may have to be effected in a country of which we may possibly have a very superficial knowledge. In cases of this kind it is essential to have a careful reconnoissance of the coast made by naval and military officers, to whom should be intrusted the selection of a suitable landing place, which may be subsequently turned into a base of operations if necessary.

The essential conditions for establishing a sea base of operations in as brief a space of time as possible are:

First. A system of loading the vessels at home which will allow of their contents being landed in the order of their requirement, and

of dispatching both troops and stores in the succession in which it is intended to put them ashore.

Second. The appointment of a really capable and energetic officer as base commandant, with a sufficient staff of officers and subordinates well acquainted with the details of embarkation and disembarkation.

Third. The selection of two competent officers, one to undertake the duties of chief naval transport officer and the other of military landing officer.

Fourth. The detail of a detachment of engineers or some similar body for placing the base in a state of defense, for improving the wharves and roads, adapting buildings for the reception of stores, etc.

Fifth. The provision of a body of laborers to undertake the discharging of the vessels and for employment at wharves in loading carts and pack animals.

Sixth. Ample means of land transportation to clear the wharves as the vessels are gradually unloaded and to remove provisions and stores to such localities as have been set apart for their reception.

The arrangements at the base are placed under the supreme direction of an officer, styled the "base commandant." Here it is necessary to observe that the administration of the base is too vital a charge to be confided to an untried officer, and that it should never be intrusted to one of only average ability. An established character for hard work, attention to details, untiring zeal, and a robust constitution are necessary qualifications for the post. A knowledge of the language of the country and a familiarity with embarkation duties are further desirable acquirements.

However able and untiring the officer selected as base commandant may be, however creditably he may have performed other staff duties, he will find his duties novel and embarrassing. It is next to impossible, in time of peace, to become practically acquainted with many of the details which will exact his attention. All demands will be urgent, all must be met without delay; a multitude of important matters will have to be attended to instantly—nothing can be overlooked or postponed.

As the organization of the base must be completed in as short a space of time as possible, the officer who has to start it should be one of the first to leave our shores. He should not be satisfied with the arrangements that have been made for him; he is bound to look to his probable requirements, and must consequently submit his demands for all he may need in point of personal assistance in officers and non-commissioned officers, in the way of materials, etc. He should expedite his departure and sail with all he deems indispensable and with full powers to act according to the best of his abilities.

A fast steamer should sail at a very early date with the establishment for the base of operations. This ship should convey the base commandant, the chief naval transport officer, the military landing

officer, officers of the medical, quartermaster, commissary, and ordnance departments, and a wharfmaster. These officers should be accompanied by their respective assistants, clerks, storekeepers, and issuers. A contingent of engineers and a small body of laborers for handling the stores should also be carried.

If possible the vessel should also carry a supply of iron-shod piles and timber for additional light wharves, some wheelbarrows, a few blackboards, to use as directing posts, and a sufficient quantity of tarpaulins to protect the stores from heavy dew and rain.

The early departure of the staff for working the base, on which is set such great importance, applies equally to those cases in which the intended port is to be seized by stratagem or its selection requires to be kept a profound secret. In such cases the staff should be kept ready at hand so as to be ready to embark with the first troops.

Immediately after landing, the base commandant, after having appropriated suitable quarters and offices for himself and staff, will have to assume the general direction of the work. At this period he will not have a free hand. The presence of army headquarters and of the chief of communications at the base must to a greater or less extent lead to a certain interference in his dispositions, and he must subordinate his ideas to any instructions he may receive. With the chief of communications there will be a number of officers who are intended for duty on the lines of communications. Until the army moves forward, and the communications develop themselves, some of these officers will be available to aid the base commandant at this pressing moment.

Except when a considerable body of troops is located at the port of disembarkation, the base commandant, whatever may be his rank, will be the controlling officer of the place. He must concert his measures with the local authorities, from whom he should exact all the assistance which is in their power to render him. Possibly the local authorities may have withdrawn or may have relinquished their duties, in which case he must at once replace them by appointing some of the most influential citizens, or, in default of them, officers from the Army or Navy.

While the purpose of this article is to draw attention to the many points which will have to be attended to on the formation of a sea base, it will be admitted that frequently a multitude of adverse circumstances will allow the base commandant to make nothing more than temporary arrangements. The natural anxiety of the general commanding to see his troops on shore and the feverish craving of the officers to do something after the confinement and monotony of life aboard ship will increase the difficulties of his task. Rarely will he have time to perfect his dispositions until the landing of the troops has been completed.

In looking at the work which he will have to regulate, the disembarkation of the troops naturally forces itself first on our attention. This first period of the occupation will not last long, still it is one of

great pressure, and will seldom permit of much heed being paid to many measures necessary for the orderly and systematic working of a sea base of operations. As the disembarkation of the troops and stores is the first matter that will take the energies of the commandant, and as the base can hardly get into thorough working order until it is accomplished, it will be well to commence by reviewing the measures necessary for conducting a considerable landing with order and speed.

THE DISEMBARKATION.

A perusal of the narrations of many expeditions where a landing was effected in an enemy's country will show how a certain amount of bustle and disorder has always accompanied the early stages of all disembarkations. The work of landing in the shortest space of time thousands of infantry, cavalry, artillery, and engineers, with their horses, guns, ammunition, and transport wagons, and a vast quantity of stores, provisions, and materials—above all, if carried out in a confined space, with insufficient wharves and dearth of appliances—can not well be free from a certain amount of confusion. The novelty of the situation, the multiplicity of things that require to be attended to at the same moment, the impossibility of exercising a very extended supervision, and the need of expediting the work, are all elements of confusion.

The only way of reducing the bustle and confusion is to work the landing on a practical system, which should comprise a just distribution of the quays and wharves, ample supervision, abundant means of unloading the transports and clearing the stores after being landed, and the exclusion of all individuals who are not connected with the work.

The manner in which the embarkation of an expeditionary force is carried out at home has much more to do with the orderly disembarkation in a foreign country than has been generally supposed.

The leading principle to observe is the sequence in which it is intended to land the troops and stores on arrival at the base. The fastest transports and the earliest to start must naturally be given to those that have to be put ashore first. The scheme of the embarkation—and more especially with provisions, stores, and war materials—must be arranged with strict regard to the succession in which everything is likely to be required at the base. The reports at the end of every expedition show that a great improvement in this direction is necessary.

The base commandant is entirely dependent on the naval and military authorities at home in this respect, and the best arrangement on his part for conducting an orderly and speedy disembarkation will be of little use if the embarkation at home has not been conducted on proper lines.

NOTE.—The means for conveying a body of troops to a distant country are provided by the military authorities. It is not proposed to enter here into a discussion as to the efficiency of this system, but it is conceived that the best interests of the Government will be served if these transports were selected, officered by the Navy, and fitted out under the joint supervision of the naval and military authorities.

The efficiency of the disembarkation will depend greatly on the cordial relations existing between the base commandant and the chief naval transport officer, for the two must work in unison and make their measures dovetail with each other. To do this these two officers must be in direct and constant communication. This constant intercourse would hardly be possible were the chief naval transport officer to live afloat. There can be no question that, in this and other respects, his residence ashore would be very advantageous. The latter is bound to propose such arrangements as his nautical knowledge and general experience may suggest; the former is, however, bound to see how these are likely to agree with the orders and intentions of the general commanding.

NOTE.—As two separate services are concerned, it is very necessary to know the limits of the duties to be performed by each at the port of disembarkation or base.

The following is the division of the duties between the military and naval officers as laid down by the British regulations, and it is difficult to see where they can be improved upon:

The navy disembark all men and animals and unload all stores from the ships, provide the requisite boats, tugs, barges, or lighters, and deliver the loads at high-water mark, or at the wharves or piers constructed and maintained by the army. The unloading of the boats or barges will be performed by the army. The army loads all boats or barges at high-water mark, or at the piers, under the supervision of a naval officer, who is responsible that the boats, etc., are properly stowed, and who will give such instructions as he may think fit on the subject. When the boats, barges, etc., are loaded, the navy becomes responsible for their removal, and for the transshipment of their loads to the transports or other vessels.

On the arrival of a ship at the base, the chief naval transport officer will give immediate notice to the commandant, through the military landing officer, sending him a return, in general terms, of everything on board, and stating how soon he will be prepared to discharge. The commandant will then make arrangements for receiving the contents of the ship and will inform the chief naval transport officer, through the military landing officer, when and where he will be prepared to receive them. No men, animals, stores, or anything conveyed in any ship for the use of the army will be landed until the military landing officer has made a requisition upon the naval transport officer.

The foregoing are the general rules as regards the division of duties, but it is to be understood that the commandant at the base should render whatever assistance the senior naval officer asks for. Corresponding instructions have been issued to the senior naval officers to aid the officers commanding Her Majesty's troops in every way they can on application being made to them.

On all occasions when there is a duly appointed naval transport officer, the military authorities at the base have consequently nothing to do with either troops or stores until these come to land; in other words, their responsibility commences only from the moment the naval authorities bring the troops, animals, stores, and war materials to the wharves or shore, when they assume charge of them.

Water transport from ship to shore, and vice versa, is assigned to the Navy, and may be done entirely by the Navy, or by a contractor who undertakes to furnish lighters, barges, tugs, etc., charging at a specified rate for transporting animals and stores.

When a naval transport officer assumes charge of the arrangements he should take over all existing contracts for landing and shipping, giving written requisitions to the contractor for the work he is called upon to perform. When troops are thus landed under contract the military authorities must abstain from any direct action with the contractors, as the naval transport officer becomes the medium of communication.

It will always be preferable for the disembarkation and embarkation of troops, warlike stores, and provisions to be effected by the naval and military services, free from any assistance from civilian contractors; for, putting aside the question of economy, this will render the work more simple, as it will eliminate all dealings with third parties.

In landing, the naval authorities must work with the military, for the latter only are in a position to tell the former when they are free to receive the men and stores. The naval authorities must, consequently, land them only on a requisition from the military. The disembarkation of the stores can only be done with reference to the means at the disposal of the military authorities for the orderly removal of all that is landed. It is not purely a question of emptying every vessel as fast as possible, for this would conduce to an embarrassing accumulation of goods on the wharves if the means of carting them have not been provided or are insufficient.

One of the most important officers of the staff of the base commandant is the military landing officer. The special province of this officer is to settle with the chief transport officer all the details of embarkation and disembarkation, and to give his personal supervision to these operations.

Nothing is so essential as to detail an experienced and highly practical officer for this post. The duties he will have to attend to come under the following heading:

(a) The supervision of all the arrangements connected with receiving the troops, animals, stores, and war materials from the naval authorities at the landing places.

(b) The removal from the wharves and storing of all articles landed for the use of the Army.

(c) The measures for the periodical reembarkation of the sick and wounded and of the troops and surplus stores at the conclusion of the war.

The office of the military landing officer, which should be conspicuously marked on the outside in large letters, should be situated in the close vicinity of the landing place and, when practicable, in the same building with the shore office of the Naval Transport Service.

The military landing officer will have to proceed on board every transport to arrange with the officer in military charge all the details of the disembarkation. As he will be always in demand, whenever his duties take him afloat a special distinguishing pennant should be hoisted to indicate the vessel where he is to be found. Without some precaution of this kind, in a large harbor filled with ships, considerable difficulty will be experienced in communicating with him.

The military landing officer must be assisted by supply, medical, veterinary, and ordnance store officers. These officers will have to take charge of all stores landed for their respective departments, clearing the bills of lading of all transports which have conveyed such articles. All communications which departmental officers consider necessary to address to the chief naval transport officer on the subject of their stores should invariably be transmitted through the military landing officer.

Whether the landing is done by contract or not an accurate register of all that is landed must be kept by the department the stores are assigned to. All military baggage and stores landed under contract must pass through the military landing officer, so as to prevent overcharges by shipping agents for weight and measure. Everything must be weighed and measured under his superintendence, in concert with the contractor, if possible; otherwise the latter should agree to accept the military measurements. The contractor's bills should be paid on certificates signed by the military landing officer.

One or more civilian clerks, men accustomed to land and embark cargo, might be specially employed under the military landing officer. These men, skilled in checking, measuring, and loading stores, would be invaluable as shipping clerks.

Printed advices of all stores and provisions dispatched from home to the base will be naturally sent to the general of communications. We may, nevertheless, observe that it is better to send the bills of lading direct to the base commandant, as it will tend to expedite the unloading of the transport.

Signal stations must be erected at the port of disembarkation to give timely notice of the arrival of all ships, and to communicate instruc-

tions to them from the shore. Signaling will be particularly needed when the transports are obliged to anchor some distance from the shore. As information conveyed by mail or by telegraph will have apprised the staff officers at the base with the general contents of each transport about to arrive, their number, in reality, is all that they will be required to make out.

Transports engaged for a large expedition by sea receive a consecutive number, which is printed in large black figures on white patches, on both sides of the ship, at the bows and at the stern.

Each transport should be provided with two boards about 6 feet long and 4 feet broad, painted black, on which are painted in white letters 1 foot long, and broad in proportion, etc., what is on board. Each board is to be fitted with lanyards 6 feet long for hanging it over the sides when ordered.

The anchorage of the transports will depend on the instructions issued by the chief naval transport officer. Their position, however, when practicable, should be determined with due regard to the wharves and piers assigned to the troops or stores they have on board.

Where the depth of water and other conditions admit of the transports coming alongside the wharves the disembarkation will be reduced to a single operation. If the transports have to lie far from the shore, large roomy boats or lighters will have to be sent to receive the troops, equipment, guns, carriages, stores, and provisions. Tugs or steam launches are employed in towing a number of these craft at a time. These steam launches are very useful, and have now become quite indispensable for harbor work; a goodly number of them will always come in very opportunely at the port of disembarkation. Where a heavy surf breaks on the shore, or where there is a dangerous bar to cross, the landing must be effected in surf boats or special lighters.

The disembarkation must commence with the landing of the troops, for these must be put ashore as soon as practicable. In arranging the order in which these are to be disembarked the base commandant must be guided by the instructions he receives from the chief of staff. Unless the arrangements for landing are inadequate, troops of different arms should be landed simultaneously. Mounted troops require to be put ashore early, as the air in the horse decks becomes very hot and foul when the ships come to anchor. Horses also require a short time on land before being put to hard work. Any cavalry wanted for scouting will have to be landed with the first troops.

The number of transports to discharge at one time will depend entirely on the extent of wharfage, on the number of boats, lighters, etc., at the disposal of the chief naval transport officer. Only in exceptional cases can the landing of the provisions and war materials be carried out simultaneously with that of the troops. It will be found preferable to allot, first, all the available means to the latter so as to

complete their disembarkation as rapidly as possible. This portion of the work done, greater attention can be devoted to the landing of the stores, which will lead to greater regularity and expedition.

The troops have often to be exposed to some privations in the first days after landing. Ample provision may have been made for all necessary articles; indeed, the transport generally may contain much more than the troops needed at the moment, but the difficulty lies in getting at the stores needed and in the time required to arrange for regular distributions. The newspapers' reports of the want of any article raises a storm of indignation at home from people who can not appreciate the difficulties inherent to a large disembarkation. In war, with the very best arrangements, mischances often occur, and the soldier has to endure privations which are simply the consequence of an abnormal state of things. The only way to remedy this is to have a transport especially told off for the conveyance of a sufficient amount of assorted provisions with which to meet the wants of the troops until things get into thorough working order at the base.

Such a transport would become a floating magazine for the supply only of what was required for the moment, the provisions to be stowed with extra care, so that the different articles may be readily got at. It should be a fast vessel and one of the first to leave; it should bear some distinguishing pennant, and on arrival at the base should be anchored in the most accessible place. A proper staff of issuers, with the necessary implements, should go in this transport. By such arrangement the provisions in the other transports would not be interfered with while in progress of being landed; they would be simply landed in bulk and moved clear of the wharves to such places as are selected for the main magazines.

As a general rule, all troops disembarking take with them one or more days' rations; this renders them independent of any immediate assistance from the supply officers. The period of disembarkation is one of those occasions in which the emergency ration will come in very handy. There may be at this juncture some difficulty in obtaining or distributing fuel, which can be met by the issue of canned meats and other provisions that require no cooking. We should bear in mind that the supply officers will require two or three days to organize their stores before commencing the regular distributions.

When a considerable number of vessels have to discharge a large quantity of men, horses, transport animals, wagons, stores, and materials, ample wharfage room will be needed; without it, the work of landing can not be otherwise than slow, as with insufficient wharf accommodations nothing but irritating delays can occur. It will then be seen how very prudent it is to accord due consideration to the probable necessity of having to provide additional wharfage at the base. It is with this object that the dispatch of a detail of engineers has

been included among the first measures for facilitating the establishment of the base.

In those cases where there are no wharves that can be made available landing piers must be constructed. Permanent wharves are always preferable, but when those are insufficient in number or extent they will have to be supplemented by temporary constructions. Pile-driving gear with iron-headed piles ready for driving, timber for stages, spars for trestles, ropes, iron, etc., will have to be sent out so as to reach the base at the earliest moment.

Platforms on pontoons or casks, or stages resting on boats, can be used for landing troops or stores. Roomy barges can also be sunk to a certain depth and connected with the shore by a trestle bridge or causeway. These and many other means will readily suggest themselves to the engineers, who, after all, can only be guided in their choice by the actual circumstances and by the means at their disposal.

Separate landing places must be reserved for the troops of the various arms, and for the provisions, stores, etc. When practicable each arm and department should have its own. At each landing place a board should indicate what it is set apart for, a sentry, if needed, being stationed there to prevent it being used for any other purpose. At places where the troops are landed it would appear a desirable arrangement to set up boards to intimate to the officers and men that the landing is to be carried on as though at drill. We have to take into account the high spirits of the men on getting on shore after the long confinement on board ship with prospect of active service. Their excitement must be checked by the enforcement of strict discipline, all noise must be forbidden, the men must fall in as directed as soon as they set foot on shore, and marched clear of the landing place as soon as practicable.

In clearing the troopships fatigue parties from the troops on board must be told off to land the camp equipage, baggage, harness, guns, wagons, and animals. A source of trouble are the men who are not told off for fatigue. They should not be permitted to lounge on the wharves, must be kept clear of the gangways, and warned not to delay the disembarkation. The men are put ashore last, after the property of the corps is clear of the ship and the necessary preparations have been made for moving off. All sick men must be sent to the base hospital, and an officer must be detailed to collect and hand over to the proper officers on shore all such stores and documents as have to be deposited at the base.

It is always desirable that the troops should have a substantial meal before landing. On this point it may be observed that, as they have to turn in various things, and the people on the ship are anxious to be

rid of them, the last meal on board generally consists of hard-tack, canned meat, and tea or coffee. This is hardly a substantial meal for men who have to undergo heavy fatigues in landing the regimental stores and equipment and who may possibly have to march some distance after getting on shore. Commanding officers should pay attention to this point and press the ship authorities to provide some better fare.

Before landing, the company officers should see that the men's canteens are filled and that the haversacks contain plenty of provisions. These matters come under the head of regimental arrangements, still it will never be superfluous to call attention to these points in the order issued for the disembarkation, for everyone must have experienced how easily certain details are lost sight of when many things crowd on the mind at the same moment.

Should the space near the wharves be insufficient for forming the detachments, some clear piece of ground in the vicinity must be especially set apart for this purpose.

The disembarkation of the horses and transport animals can be effected in several ways. The most expeditious is when a vessel can lie alongside of the wharf and the arrangements admit of the animals being led ashore. If this is not practicable, they can be hoisted from the horse decks in horse boxes, or with slings, and swung clear of the ship onto the wharves. When the vessels are compelled to lie far from shore, large flat-bottomed boats fitted with hand rails must be towed alongside to receive the animals as they are raised from the horse decks.

The operation of landing horses from boats on the open seashore is very long and laborious. When a large number of horses have thus to be landed, unless the greatest energy is put in the business, the disembarkation will extend over a considerable period of time. Circumstances may make it necessary to expedite the disembarkation by swimming the horses ashore. The following points should be attended to in this:

(1) Each horse to have his ship head collar on; (2) tackles should be rigged up so that the horse will swing clear of the ship's side, davits, etc.; (3) the sling should be attached to the hook of the davit by an eye and a toggle—the latter will be quite secure when the weight is taken; (4) in lowering, all boats to be kept out of the way, and the weight of the horse retained until he has done struggling; his head can then be lashed to the gunwale of the boat and the toggle knocked out, which will free him at once; (5) horses' heads to be cast loose as soon as, or rather before, they feel the bottom; (6) men must be stationed on shore to receive the horses, and, if possible, a sandy place must be selected. If the distance to be swum is short, boats may be

dispensed with, but horses, as often as not, will swim seaward if left alone. If other horses are on shore they will always swim toward them.

For landing artillery, flat-bottomed boats of suitable size, if available, or a platform resting on two boats, should be used.

The disembarkation of the troops will be followed by the landing of the provisions, ordnance stores, and all kinds of war material. This vast accumulation of articles has not simply to be deposited on the wharves, but the different kinds have to be separated from each other and conveyed to such buildings as have been assigned to the various departments for their base magazines.

Their landing must be conducted with due regard to their urgency. All articles which may be required first must be consequently landed first. A copy of the bill of lading will have been delivered by the supercargo of the base commandant; the latter, guided by his knowledge of the contents of each transport, and by the demands of the departmental officers, will be in a position to mature his arrangements for the landing of stores in the order of their necessity.

The disembarkation of the stores can not be carried out expeditiously unless there are sufficient hands and land transportation to deal with all that the various vessels contain. The unloading of the ship's boats or barges has to be performed by the Army, and large fatigue parties of soldiers should apparently be detailed for this work. Here two points need consideration: First, that heavy fatigues endured under a hot sun in a strange climate are likely to affect the health of newcomers. Second, that portorage work will always be done more speedily by men who are familiar with it. In most seaport towns there is no lack of men accustomed to deal with heavy loads, and a sufficient number of carriers inured to the climate can be obtained locally. Whether they are engaged on the spot or drawn from the neighborhood is immaterial; an adequate number must, in any case, be engaged without delay, for it is of the utmost importance to take the landing of the stores and provisions in hand as soon as possible.

Experience has shown that the men secured locally, though well paid, as a general rule display no energy, and require much urging, while the difference of language makes it difficult to give orders and directions. Much of this can be overcome by making the daily pay of the superintendents and local overseers depend on the amount of work performed.

The base commandant will have to fix the rate of pay and the hours of work. Arrangements might, in some cases, be made to pay according to the actual work done by each individual, a metal tag being given for each load carried. So many of these tags would represent 50 cents or some other coin, which would be paid when settling daily at the conclusion of the work.

Nothing but land transport will provide against incumbrance on the wharves, and though this may be obtained locally, still it should not be left to chance. A small contingent sent out with the staff to the base will be found a prudent measure, for it can be set to work at once, whereas hired transport will always take some days to collect.

Considerable quantities of stores, provisions, and war materials should neither lie exposed on the wharves or beach for a long time, or be allowed to form a heterogeneous and confused mass. All must be removed as soon as possible to the localities allotted to the several departments. This can not be done unless sufficient transport is furnished to each one for that special purpose. All requisitions addressed to the military landing officer, for landing purposes, should state that transport is forthcoming for the removal of the goods from the wharves or landing stage.

The prevention of an incumbering accumulation of stores at the wharves or other landing places is a point which demands the greatest attention. A wharfmaster, under the orders of the military landing officer, should be especially appointed to supervise and regulate the work. He will have to utilize the manual labor to the best advantage, and permit no interference from unauthorized persons. He should assist the departmental officers in seeing that as the various descriptions of stores are landed they are kept distinct and deposited in the places assigned for them. These should be indicated by boards.

The wharf master should take in his charge all goods and packages whose destination is uncertain, owing to the absence of sufficient address or the destruction or obliteration of the labels. It will rest with the military landing officer afterwards to institute the necessary inquiries for ascertaining the proper consignee.

Light handcarts, wheelbarrows, and the like will prove very convenient for moving things about. A portable railway will prove an immense boon, and should form a part of the base transport for all expeditions.

The freedom from any undue accumulation of stores at the landing places will depend greatly on the number of roads leading to the warehouses, buildings, or yards assigned to the various departments for their magazines. When the roads are found insufficient new ones must be opened up without delay. Orders will have to be issued in any case to regulate their traffic, so that they may be at all times as clear as possible from obstruction.

If the wharves are unconnected with a railway, every effort should be made to connect the landing places with the nearest line. This measure should not be neglected, for it will facilitate to a very considerable extent the removal and the forwarding of the stores, provisions, and materials.

The diary of the base commandant should contain a complete daily

record of the arrival of transports, number of troops and animals disembarked, quantity and description of warlike material, stores, and provisions landed, and other work performed. The departure of all drafts and convoys, the sailing of all transports, the embarkation of sick and wounded, prisoners of war, etc., are all points that require to be registered in his diary.

The work of disembarkation has hitherto occupied our attention. There are, however, many arrangements to be made at the base which must be carried on simultaneously with the landing. Prominent among these is the appropriation of buildings for hospitals, barracks and magazines, staff, departmental, postal, telegraph, and police offices. The civil authorities must be directed to indicate the most suitable buildings which can be handed over to the military, and, as any of these are so allotted, they will have to take the necessary steps for their evacuation. The nature of any building taken over for army purposes should be shown in large letters on the main entrance, both in the vernacular of the Army and of the country.

The best edifices must be set apart for the reception and treatment of the sick and wounded. In their selection the base commandant must be guided by the advice of the senior medical officer at the base, while the senior engineer officer must be invited to suggest what structural alterations will be required to make them fit for the accommodation of the patients. Pending their adaptation, a base hospital may have to be provisionally established under some other roof, for the medical officers will need an establishment of this sort in which to place any sick men landed from the transports.

A small sanatorium for officers in the vicinity of the main hospital will be found a great convenience.

The troops which are to constitute the garrison of the base must be quartered with due consideration to the protection of the place. If we bear in mind the many guards they will have to furnish and the many fatigues on which they will be employed, it will be seen that it is not unreasonable to demand for them comfortable quarters, where they can find the rest they will need.

The necessity for installing the postal and telegraph offices as soon as possible is apparent. Convenient quarters must be found in the most accessible localities, if the town has no regular establishments of this kind.

Spacious buildings, warehouses, and yards will be required for the reception of military stores and provisions. These should be situated in accessible localities, being isolated, if practicable, so as to avoid all risks of fire. In the absence of suitable buildings for this purpose, the senior engineer officer will have to suggest what sheds can be erected for the safe custody of all perishable articles. When there is

no prospect of finding buildings of any sort at the base, huts of timber frames and corrugated iron will have to be sent from home.

When there are no buildings which can be appropriated for the reception of provisions and warlike stores, or there is a deficiency of materials for the erection of sheds, the stores can only be stacked in the open. In such cases a plentiful supply of tarpaulins must be kept handy to cover all articles that are likely to be injured by exposure.

A good arrangement is to select a level and dry piece of land for this purpose and divide it with stones or white-painted lines into square spaces. Each of these spaces can be reserved for a special description of stores, and indicated by a board. Broad passages should intersect these spaces, so that the wagons, carts, and pack animals may circulate freely.

Special isolated buildings in unfrequented localities must be set apart for the safe custody of ammunition, gunpowder, dynamite, and other combustible material. Buildings for this purpose may require extensive alterations before they can be considered safe.

All officers in charge of ammunition, provisions, stores, or public goods must apply to the base commandant for a sufficient guard to look after Government property for which they are answerable.

A baggage storeroom is very necessary at the base, in which to put officers' boxes, company boxes, and other surplus property landed with each corps, or that may be sent from home during the operations. A portion of this baggage room, conveniently situated with regard to the landing places, should be assigned for the exclusive use of each fighting unit, a steady and reliable man from each body being detailed to take charge of it. This man will have to keep a correct register of all articles received, showing how these have been disposed of from time to time. He will have to take his orders from the commanding officers of the depot cadres at the base for the transportation to the headquarters of his battalion, battery, or company, or to the advanced depot, of any articles which have been intrusted to his custody. A noncommissioned officer could be placed in charge of these regimental storekeepers, acting as a kind of baggagemaster, with a few laborers hired locally to assist him.

The sorting of the articles to be left at the base should be done on board ship before the troops are landed. The military landing officer must give any special instructions on this point to the commanding officers as early as practicable. Packing the surplus clothing in squad bags will lead to economies of space in the baggage room. Each bag should be clearly marked outside with the letter of the company, and should bear a wooden tally firmly fixed to it. A list showing the number of bundles and the name and regimental number of the owner of each should further be pasted inside of it. Each bundle should be

securely tied and marked with the owner's name, to facilitate the finding of his property should he be invalided or reembark independently of his company or troops. Kit bags before being consigned to the baggage room should likewise bear a pasted label, or better still, a metal tally bearing the owner's name.

A sick-animal depot must form one of the arrangements at the base. Stables or sheds must be found in which to locate all such animals as are landed in a debilitated condition or injured. The veterinary surgeon at the base should have a voice in the selection of buildings for this purpose. As soon as a depot for remounts is established at the base this temporary sick-animal depot will naturally merge into it. The great point at the port of disembarkation being to eliminate every element of confusion and disorder, it stands to reason that the troops other than the necessary garrison must be kept out of it as much as possible. Troops in the town would only add to the number of idlers to fill the thoroughfares and could only obstruct the work. The officers of the headquarters staff must select a clean, healthy site for encamping the troops. This camp should lie a few miles beyond the town in some locality abounding in good water and fuel, and all troops should be marched to it on first landing. Independent of this general camping ground the base commandant, in consultation with his sanitary officer, must select a suitable site for a standing camp. A camp commandant who should be made an accountant must subsequently be appointed to draw the necessary camp equipment, and make all the necessary preparations for receiving such troops as may be temporarily accommodated at the base. Portions of this standing camp must be set apart for the sole use of the remount establishment, the transport, and the slaughter cattle. The difficulty of watering a large number of animals, may, however, render it necessary to form special camps in localities more within reach of the water supply. All drafts, individual officers, noncommissioned officers, and soldiers on first landing; all men coming out of the hospital, all prisoners on the expiration of their sentence, and all detached officers, noncommissioned officers, and soldiers for reembarkation, should be taken up on the rolls of the standing camp.

It should be observed here that detached men arriving from the front will need special attention. They will be frequently ailing and not able to look after themselves. Frequently they arrive at the base without suitable clothing, with a minimum of kit, and with their accounts unsettled, there being no one belonging to their corps to render a proper account of them. The officers of the depot cadre must assume charge of them, attend to all their wants, demand or collect their documents, and prepare all those ordered to reembark with a suitable kit for the voyage.

A detachment of military police must be detailed for duty at the

standing camp and a proper provost prison for the custody of military offenders and courts-martial prisoners must be provided at the base. To this all prisoners must be sent at the first opportunity.

It is well here to call attention to certain matters with regard to the harbor and town which will demand the attention of the commandant.

The sanitary conditions and cleanliness of the harbor is a matter of vital importance, and attention should be paid to it from the very first. On this point may be quoted a passage from the orders with regard to Balaclava:

The sanitary commission arranged with the admiral * * * to have two flat-bottomed boats manned to act as scavengers' carts, going around every morning and evening from ship to ship to receive any refuse and take it outside and discharge it in the sea, into deep water.

All carcasses floating in the harbor were also towed out to sea and cut up so as to sink. Cattle steamers were ordered to bank fires and discharge cargo; then to fire up, go out to sea 5 or 6 miles from shore, clean decks, and come in and wait for orders.

It will be of the highest importance to look after the sanitary condition of a town through which thousands of troops are to pass, and which a large number of seamen may be continually visiting. The town must be placed without delay, in charge of a sanitary officer (who should be a medical officer) who will give his attention to the water, drainage, refuse yards, latrines, situation of burial grounds and slaughter yards. Should the existing arrangements show any lack of sanitary precautions, he will demand suitable conservancy establishments, provided with water carts, refuse carts, and other necessary appliances.

In the interests of the inhabitants and of the army, the local magistrate, justices of the peace, and other functionaries must be persuaded to remain in office, and a body of police, both foot and mounted, must be organized. This is indispensable, as spies and all sorts of questionable characters are sure to flock to the port of disembarkation. Extra intelligent men should be employed as detectives, to look especially after suspicious individuals and to apprehend spies. With the detachment of military police detailed for duty at the base should be associated a certain number of local police to deal with native working parties, transport drivers, and servants, and to assist in detecting crime among their own people. As few strangers as possible should be permitted to land, and all individuals who can not render a satisfactory account of themselves must be kept under the eye of the police. A register of sutlers must be opened, and each one should be furnished with a printed pass, which should contain at the back such regulations as he will be bound to observe.

Particularly at night the streets must be patrolled by the police or by pickets, when all soldiers or sailors out of quarters, and all dubious or disorderly people must be taken up. For this purpose police sta-

tions or guardhouses with cells will be required in various portions of the town. In a town where the streets are badly lighted, steps should be taken to remedy this defect.

When the people are unquestionably hostile they must be compelled to remain indoors after a certain hour, except those individuals who can show a special and legitimate reason for being outdoors after dark. It becomes then necessary to restrict all soldiers and sailors to their quarters or to their ships after dark, and to abstain from giving passes after sundown.

Particular restrictions must be placed on the sale of intoxicating drinks. The base being a place for work, the greatest order must be maintained. Drunkenness and riotousness there must be put down with a strong hand.

To guard against having a number of noneffectives, rigorous measures must be concerted with the sanitary officer to minimize the possibility of infection through diseased women of loose character; all diseased ones must be at once either removed or confined in a proper hospital or in a place set apart for the purpose. The police officer should be instructed to report in detail to the officer in charge as to the localities and houses frequented by improper characters, in order that efficient measures may be enforced to prevent disease, disorder, and crime.

The rear of every army is infested by a large number of traders, gypsies, greedy and dishonest vagabonds. These harpies provide the soldier with strong drinks, relieve him of his little ready cash, and make a small trade by robbing the dead and wounded. At a sea base it is possible to limit this evil to a considerable extent if stringent measures are taken in time to prevent the landing of this foul pest.

All foreign officers, newspaper correspondents, and people not directly connected with the army should be called upon on landing to register their names and addresses in a book kept for that purpose. None of these should be permitted to visit the army unless provided with a proper passport issued by the base commandant. This officer will receive from the chief of communications the necessary instructions with respect to individuals who are to be allowed to go to the front. Some assistance in the way of rations, camp equipage, and transport may have to be given to foreign officers and special correspondents under certain conditions, when the poorness of the country and other circumstances do not admit of their making their own arrangements.

It will be very convenient to have an inquiry office at the base, where officers and other individuals, on landing, may obtain any local information they may be in need of. Some small building close to the main landing place may be appropriated for this purpose, being marked "information office." By such a simple arrangement, officers

and clerks will be saved the continual interruption in their work which ensues from people constantly coming to seek information.

A small directory will be of great assistance to new arrivals. This should contain a map of the place; a list of the military and local authorities and of the principal buildings appropriated for military purposes; tariff for conveyances and transport; list of principal tradesmen; postal, telegraphic, and clerical information; railway time tables; local weights and measures; relative value of money, etc.

Arrangements must be made for alarm sounds in the event of fire. As fire may do much injury to shipping, especially in a crowded harbor, and may consume large quantities of forage, provisions, and warlike stores which can not be easily replaced, nothing demands greater attention. If there are no fire engines forthcoming, some may be obtained from the men-of-war or transports, being kept ready at the wharves or posted near the principal magazines with parties of soldiers to work them. It must be further ordered that every able-bodied man will be considered bound to render assistance in case of fire.

The time of day will be given by the base commandant. It must be kept as the correct time by the town, and the working hours will be regulated by it. The local time can be obtained either by observation or by telegraph; it can be published by the firing of a gun, or by the sounding of some special bugle call, which should be immediately taken up by all the guard trumpeters of the place.

There are some other matters which should be noticed in referring to the local arrangements at the base. Among these is the establishment of good markets for the sale of vegetables, poultry, meat, groceries, and fruit. Every inducement should be offered to the inhabitants of neighboring villages to bring in supplies and to offer them for sale. There will always be a great demand for them, not only on the part of the garrison, but also to meet the requirements of the hospital, and of the ships, both coming and going.

The provision of a plentiful supply of good drinking water is of the utmost importance. Water will not only be needed for the troops, for the animals, and for the town's people, but the ships will require a considerable quantity to fill their tanks before going to sea.

The means of supplying a large number of steamers and engines with fuel must always be forthcoming. This indicates the absolute necessity for establishing a large coal yard with many tons of coal. The chief naval transport officer may have instructions to attend to this matter, nevertheless the base commandant should not overlook it, and should assign some convenient locality where the coal can be stored. Tugs, lighters, baskets, sacks, and shovels must form part of the depot, with sufficient hands for the work.

After the disembarkation has been completed, the principal portion of the work at the base of operations will consist in forwarding reen-

forcements, remounts, provisions, stores, and warlike material to the front. All arrangements for doing so must naturally depend on the instructions issued by the chief of communications. This officer being responsible for the supply of everything which the army will need during the course of the operations, must be at all times in possession of an exact statement of the resources of the base. The base commandant must consequently call on the departmental officers on his staff to furnish periodical returns for transmission to the chief of communications, showing the actual state of their resources.

According to such instructions as he may receive, the base commandant will have to issue orders from time to time for detachments to quit the base and proceed to the front. He is responsible that each detachment is provided with a sufficient escort of officers and non-commissioned officers; and that the depot officers equip the men of each draft with everything required by regulations. He must likewise so arrange the march of remount parties that the remount establishment at the advance depot may always be in a position to meet the waste in horses and transport animals.

If the troops or patients have to pass from a warm to a cold climate, it is well to provide suitable clothing for them. When practicable, a small supply of old overcoats, woolen socks, flannel shirts, and boots should be kept at the base hospital for free issue in cases of sudden need, or for individuals hurriedly ordered to embark.

Complete returns of troops, invalids, and other details leaving for home must be transmitted by the base commandant to the military authorities at home, by mail, so as to allow proper preparations being made for their reception and disposal on arrival.



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